COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF INTERNAL AFFAIRS

OIL AND GAS DEVELOPMENTS IN THE NORTH STRABANE AREA WASHINGTON COUNTY PENNSYLVANIA

By

CHAS. R. FETTKE,
ROBERT C. STEPHENSON
AND E. M. TIGNOR

TOPOGRAPHIC AND GEOLOGIC SURVEY
BULLETIN M 28
1946

PENNSYLVANIA
GEOLOGICAL SURVEY
FOURTH SERIES

BULLETIN M 28

OIL AND GAS DEVELOPMENTS IN THE NORTH STRABANE AREA WASHINGTON COUNTY, PENNSYLVANIA

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CHAS. R. FETTKE and ROBERT C. STEPHENSON

With a Chapter on

CORE ANALYSIS DETERMINATIONS OF DIAMOND CORE FROM J. L. KENAMOND No. 1 WELL

By

E. M. TIGNOR

DEPARTMENT OF INTERNAL AFFAIRS
WILLIAM S. LIVENGOOD, JR., *Secretary*

TOPOGRAPHIC AND GEOLOGIC SURVEY
RALPH W. STONE, *State Geologist*
Harrisburg, Pa.

1946

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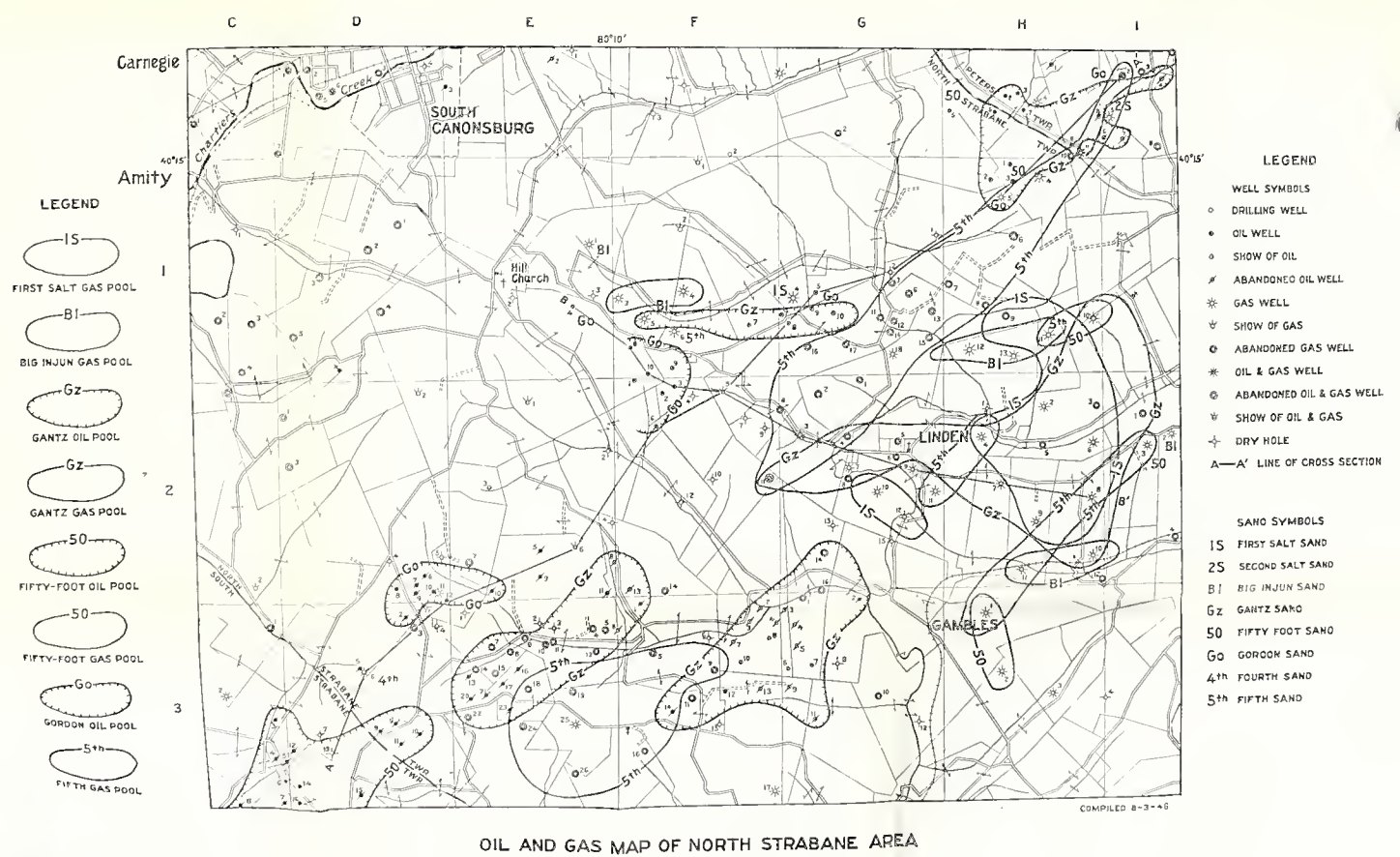
saturation, and other properties of the oil sands of southwestern Pennsylvania. The work was done as part of the coring program for which certain funds were made available by the Pennsylvania Legislature in 1945. Through a co-operative agreement with the Franklin Petroleum Field Office of the United States Bureau of Mines, porosity, permeability, and saturation determinations were made on the samples selected from the core by E. M. Tignor of the Bureau's staff.

On account of the considerable amount of new drilling that resulted from the Gordon Sand discovery, it was decided to study a small area in detail. All wells known to have been drilled for oil or gas in the area have been located on the farm line map shown in plate I. Every effort was made to obtain as complete logs and results of drilling as possible for these wells. This information is complied in table 3 of the appendix. Unfortunately, little or no information is available for many of the older wells. Elevations of the wells for which logs were obtained were taken with a Paulin altimeter. The Peoples Natural Gas Company and Charles E. Young furnished complete sets of drill-cutting samples from three of the wells, from which sample-study logs have been prepared. Drillers' logs were plotted in strip form for purposes of well to well correlation and comparison with the sample-study logs. The correlations are those of the writers.

The area studied is included in the Amity quadrangle of the United States Geological Survey with one-half minute overlap into the Carnegie quadrangle on the north. For purposes of reference, the 15-minute quadrangles have been subdivided into 225 one-minute rectangles. From north to south the rows of rectangles are numbered from 1 to 15 consecutively, and from west to east lettered from A to O. The numbers appear at the left hand side of the map of plate I and the letters at the top. In each one-minute rectangle, a number has been assigned each well, starting with 1. The first number in a well designation, therefore, refers to the horizontal row of the one-minute rectangle in which it is located; the letter which follows, the vertical row; and the second number, the number of the well in the rectangle.

Subsurface structure maps of the North Strabane area have been constructed that show the elevation with respect to sea level of the bottom of the Pittsburgh coal (fig. 2), and the top of the Loyalhanna limestone, called top of the Big Injun sand by drillers (fig. 3). Similar maps have been drawn to show the elevations of the bottom of the Gordon sand (fig. 4), and the top (fig. 5). The thickness of the Gordon sand has been depicted on an isopach map (fig. 7). Maps have been prepared showing the configuration of the bottom of the Gordon sand (fig. 8), and the top (fig. 9), with structural deformation eliminated.

In the construction of these maps it was assumed that the top of the Loyalhanna limestone at the time of deposition represented an almost level surface and, also, a plane of time equivalence, at least over the local area, and that, if the later deformation had not occurred, this level surface today would lie approximately 300 feet below sea level. It was also assumed that relatively little deformation of the strata, with the possible exception of slight regional tilting, occurred in the



OIL AND GAS MAP OF NORTH STRABANE AREA

Scale

0 5000 10,000 FEET

Plate 1. Oil and gas map of North Strabane area.

time interval that elapsed between the deposition of the Gordon sand and the deposition of the Loyalhanna limestone and that a restoration of the configuration of the bottom and the top of the Gordon sand at the time of the deposition of the Loyalhanna limestone very nearly represents the original configuration of these surfaces.

Configuration maps were prepared to show the shape of the bottom and top of the Gordon sand at time of deposition (figs. 8 and 9). To show the original configuration of the sand body, it was necessary to eliminate the effects of subsequent deformation from present sea level elevations, since the elevations portray a composite of shape and structure. Compensation for deformation of the sand was made by correcting the sea level elevations of the sand surfaces by the amount necessary to eliminate structural relief from the datum of reference, the top of the Loyalhanna limestone. The resulting maps of sand surface configuration indicate the character of the sand at time of deposition.

Southwest-northeast and northwest-southeast correlation sections, using the top of the Loyalhanna limestone as a datum of reference, show the sands are below this horizon (see pl. 2). Interpretative cross sections of the sands of the third zone of the Conewango group are shown in figure 9. These are aligned on the top of the Fifth sand.

Topography and Drainage

The North Strabane area is part of the Allegheny plateau. It is drained on the west by Chartiers Creek and on the east by Little Chartiers, two northerly flowing streams. The region is hilly and well drained. Slopes are relatively steep. The maximum relief is about 500 feet. Most of the land has been cleared and is either under cultivation or used as pasture.

STRATIGRAPHY

Information on the stratigraphy of the North Strabane area was obtained largely from drill-cutting samples and the drillers' logs. Outcrops are few.

Complete sets of drill-cutting samples from Charles E. Young's Harry Hatfield No. 1 well (Amity 2E6) and the Peoples Natural Gas Company's Mary W. Neill and Wallace Hamilton No. 1 wells (Amity 2F5 and 2I3, respectively) were examined under a binocular microscope. Detailed descriptions of the strata encountered are given below:

Chas. E. Young et al., Harry Hatfield No. 1 Well

North Strabane Township, Washington County, Pa.
Completed January, 1946. Elevation 1343

Thickness feet	*Description of strata, by Chas. R. Fettke*	*Depth in feet Top*	*Bottom*
	Permian system, 270+ feet.		
	Washington group, 270+ feet.		
140	No samples	0	140
4	Shale, very dark gray, silty, with considerable interbedded gray silty clay	140	144
18	Limestone, very fine, dense, light to very dark brownish-gray, argillaceous, with some interbedded gray silty clay and some very dark gray silty shale, *Lower Washington*..	144	162
3	Clay, dark gray, silty, with some interbedded very dark gray silty shale	162	165

Thickness		Depth in feet Top	Bottom
5	Coal, containing much pyrite, with considerable interbedded grayish-black shale, *Washington*	165	170
21	Shale, gray to dark gray, sandy and micaceous, containing minute fragments of carbonized plant remains in lower part	170	191
9	Sandstone, very fine, light buff, slightly calcareous, containing some muscovite, *Washington*	191	200
5	Clay, gray, with considerable interbedded very fine dense, light to very dark brownish-gray limestone and a little grayish-black shale	200	205
5	Sandstone, very fine-grained, light buff-gray, somewhat calcareous, containing some muscovite	205	210
7	Shale, dark gray, silty	210	217
3	Shale, gray, sandy and somewhat micaceous, containing minute fragments of carbonized plant remains	217	220
10	Shale, dark gray, silty, containing some siderite concretions	220	230
10	Limestone, very fine, dense, grayish-brown, argillaceous, with a little interbedded slightly calcareous gray clay	230	240
25	Shale, gray, sandy and micaceous, containing some dark grayish-brown siderite concretions in lower part	240	265
5	Shale, very dark gray to grayish-black, *Cassville*	265	270
	Pennsylvanian system, 1388 feet.		
	Monongahela group, 305 feet.		
30	No samples	270	300
	Top of Waynesburg limestone	300	
20	Limestone, very fine, dense, light buff to buff-gray, argillaceous, containing fragments of minute shells, with a little interbedded gray clay	300	320
22	No samples	320	342
20	Limestone, very fine, dense, buff-gray, argillaceous, with considerable interbedded greenish gray to gray clay	342	362
	Bottom of Waynesburg limestone		362
6	Sandstone, very fine-grained, light, greenish-gray, *Uniontown*	362	368
	Top of Uniontown limestone	368	
27	Limestone, very fine, dense, light buff-gray, argillaceous, with some interbedded gray to dark gray, slightly calcareous clay	368	395
10	Limestone, very fine-dense, light buff-gray, argillaceous, with considerable interbedded gray to dark gray clay and some greenish-gray shale	395	405
15	Limestone, very fine, dense, light buff-gray, argillaceous, with some interbedded greenish-gray shale	405	420
	Top of Benwood limestone	420	
15	Limestone, very fine, deuse, light to dark buff-gray, argillaceous and somewhat magnesian	420	435
10	Limestone, very fine, dense, buff-gray, argillaceous, with some interbedded greenish-gray shale	435	445
11	Limestone, very fine, dense, buff-gray, argillaceous, with some interbedded light gray clay	445	456
	Bottom of Benwood limestone		456
1	Coal, with some interbedded black shale, *Sewickley*	456	457
3	Shale, gray, sandy and silty	457	460
5	Shale, very dark gray to grayish-black, silty	460	465
5	Shale, dark gray, sandy and micaceous	465	470
10	Sandstone, fine-grained, light gray, micaceous	470	480
10	No samples	480	490
15	Limestone, very fine, dense, light grayish brown, little interbedded gray clay, *Fishpot*	490	505
10	Clay, dark gray, with some interbedded very fine, dense, light grayish-brown limestone and some light gray, silty and micaceous shale	505	515
17	Shale, light gray, sandy and micaceous, with some interbedded dark gray clay and some very fine, dense, light grayish-brown limestone	515	532
7	Clay, brownish to very dark brownish-gray, in part calcareous	532	539
1	Shale, black	539	540
34	Shale, dark gray, silty and sandy, micaceous, containing minute fragments of carbonized plant remains in upper part	540	574
1	Coal—mined out, *Pittsburgh*	574	575
	Conemaugh group, 627 feet.		
	Top of Pittsburgh limestone	575	
4	Limestone, very fine, dense, dark grayish-brown, argillaceous, with some interbedded gray clay	575	579
5	Shale, gray, silty and micaceous, with considerable interbedded very fine, dense, dark grayish-brown argillaceous limestone	579	584

Thickness		Depth in feet Top	Bottom
5	Clay, gray, with considerable interbedded very fine, dense, light grayisb-brown, argillaceous sandstone	584	589
10	Sbale, light gray, silty, containing some muscovite, with considerable very fine, dense, grayish to dark grayish-brown, argillaceous limestone	589	599
18	Limestone, very fine, dense, light grayish-brown, argillaceous, with some interbedded gray clay and some light gray silty shale containing some muscovite	599	617
	Bottom of Pittsburgb limestone		617
7	Shale, light gray, silty, containing some muscovite, with some interbedded gray clay	617	624
31	Shale, gray, in part silty and micaceous	624	655
10	Clay, variegated, gray to red, containing abundant calcareous concretions	655	665
10	Shale, greenish-gray, sandy and micaceous	665	675
11	Sandstone, very fine-grained, light greenish-gray, micaceous	675	686
32	Clay, variegated, light grayish-green to red, containing abundant calcareous concretions	686	718
59	Clay, brick-red, calcareous, *Wellersburg*	718	777
	Top of Birmingham shale	777	
33	Sbale, greenish-gray, silty	777	810
12	Shale, greenish-gray, with some interbedded gray sandy shale	810	822
	Bottom of Birmingham shale		822
7	Clay, greenish-gray, somewhat calcareous, containing calcareous concretions	822	829
	Top of Pittsburgh red beds	829	
9	Shale, brick-red	829	838
14	Clay, brick-red, with some interbedded greenish-gray, somewhat calcareous clay and a little greenish-gray silty shale	838	852
41	Clay, variegated, greenisb-gray to brick-red, containing some calcareous concretions	852	893
	Bottom of Pittsburgh red beds		893
19	Sbale, greenish-gray, silty and somewhat calcareous	893	912
35	Sbale, greenish-gray, sandy and somewhat micaceous	912	947
20	Sandstone, fine-grained, light greenish-gray, slightly calcareous, containing minute fragments of carbonized plant remains and a little muscovite, *Saltsburg*	947	967
5	Shale, greenish-gray, sandy	967	972
22	Clay, variegated, gray to brick-red, slightly calcareous and containing some calcareous concretions	972	994
6	Shale, greenish-gray, sandy	994	1000
18	Shale, greenish-gray, silty	1000	1018
30	Shale, dark gray, sandy and micaceous	1018	1048
19	Shale, dark gray, silty, with a little interbedded fine-grained, light gray sandstone	1048	1067
	Top of Buffao sandstone, Little Dunkard	1067	
18	Sandstone, medium-grained, light gray, friable	1067	1085
10	Sandstone, fine-grained, light gray, moderately friable	1085	1095
	Bottom of Buffalo sandstone		1095
1	Shale, dark gray	1095	1096
1	Coal, *Brush Creek*	1096	1097
1	Clay, gray	1097	1098
12	Sandstone, very fine-grained, light-gray, slightly calcareous, with some interbedded dark gray clay and shale	1098	1110
7	Clay, gray	1110	1117
2	Limestone, very fine, dense, light gray	1117	1119
26	Clay, ligbt gray to gray, containing a few light gray, calcareous concretions in lower part	1119	1145
40	Shale, gray	1145	1185
10	Sbale, gray, with some interbedded light greenish-gray, silty sbale	1185	1195
7	Shale, gray	1195	1202
	Allegheny group, restricted, 168 feet.		
1	Coal, *Upper Freeport*	1202	1203
8	Shale, dark gray	1203	1211
20	Shale, light gray to gray, silty, containing some minute siderite pellets	1211	1231
10	Shale, gray, silty, containing some muscovite, with a little interbedded very fine-grained, light gray, micaceous sandstone	1231	1241
5	Shale, gray to dark gray	1241	1246
2	Coal, *Lower Freeport*	1246	1248
5	Shale, gray to dark gray	1248	1253
32	Clay, gray, witb a little interbedded fine-grained, light gray sandstone	1253	1285
37	Shale, dark gray, in part silty	1285	1322
28	Sbale, dark gray, sandy, containing some muscovite, with a little interbedded dark gray shale	1322	1350
20	Sbale, dark gray, in part silty	1350	1370

Thickness		Depth in feet Top	Bottom
	Upper Pottsville—Kanawka series, 288 feet.		
25	Sandstone, very fine-gralned, light gray, slightly calcareous and containing some muscovite, with some interbedded gray sandy shale, Kittanning, First Gas sand	1370	1395
58	Shale, dark gray, silty, containing minute fragments of carbonized plant remains	1395	1453
	Top of Clarion sandstone	1453	
7	Sandstone, fine-grained, light gray, containing minute fragments of carbonized plant remains and a little coal, with considerable Interbedded dark gray shale, in part silty	1453	1460
5	Sandstone, medium-grained, ligbt gray, with considerable interbedded dark gray silty sbale and a little very dark gray shale	1460	1465
4	Sandstone, fine-grained, light gray, with some interbedded dark gray sbale	1465	1469
	Bottom of Clarion sandstone		1469
2	Coal, *Brookville*	1469	1471
4	Shale, gray, sandy, with some interbedded gray sbale	1471	1475
	Top of Homewood sandstone, First Salt sand	1475	
15	Sandstone, medium-grained, light gray, almost white	1475	1490
1	Sbale, gray, silty	1490	1491
19	Sandstone, coarse-grained, ligbt gray, almost white	1491	1510
10	Sandstone, medium-grained, light gray, almost wbite	1510	1520
5	Shale, dark gray, silty and micaceous	1520	1525
5	Shale, dark gray, sandy and micaceous	1525	1530
28	Sandstone, coarse-grained, light gray, almost white, containing a little muscovite	1530	1558
	Bottom of Homewood sandstone		1558
12	Shale, grayish-black, containing pyrite, wlth some interbedded dark gray shale	1558	1570
10	Shale, dark gray, sandy, containing some muscovite	1570	1580
10	Shale, dark gray, in part silty, with some interbedded very light gray siltstone	1580	1590
18	Shale, very dark gray to grayisb-black, witb considerable interbedded very ligbt gray siltstone	1590	1608
22	Shale, very dark gray, with some interbedded dark gray, silty shale	1608	1630
10	Shale, very dark gray, silty	1630	1640
18	Shale, very dark gray, silty, with some interbedded grayish-black shale	1640	1658
	Mississippian system, 634 feet.		
	Greenbrier group, 112 feet.		
20	Limestone, very fine, dense, light brownish-gray, slightly argillaceous	1658	1678
28	Limestone, very fine, deuse, grayish-brown	1678	1706
	Top of Loyalhanna limestone	1706	
17	Sandstone, fine-grained, light gray, calcareous	1706	1723
47	Limestone, fine-grained, light greenisb-gray, sandy, with fine to medium size quartz grains, larger of which are subrounded and frosted	1723	1770
	Pocono group, 522 feet.		
	Top of Big Injun sand	1770	
20	Sandstone, very fine to fine-grained, light gray, slightly calcareous and containing a little muscovite—show of gas at 1783 feet	1770	1790
10	Sandstone, very fine-grained, light gray, containing a little muscovite	1790	1800
99	Sandstone, fine-grained, light gray, containing a little muscovite—a little gas, 1810-1813 feet	1800	1899
	Bottom of Big Injun sand		1899
61	Shale, dark gray, in part silty, with a little interbedded very fine-grained, ligbt gray sandstone and greenish-gray sandy shale	1899	1960
20	Shale, greenish-gray, sandy, containing some muscovite, with some interbedded dark gray shale	1960	1980
50	Shale, dark gray, silty, with a little interbedded, very fine-grained, light gray sandstone	1980	2030
30	Shale, dark gray, silty, with considerable interbedded very fine to fine-grained, light greenish-gray sandstone	2030	2060
60	Shale, dark gray, in part silty, with a little interbedded very fine-grained, light greenish-gray sandstone and a little greenish-gray siltstone	2060	2120
90	Shale, dark gray, with some interbedded greenish-gray sandy and micaceous shale	2120	2210
10	Shale, dark gray, micaceous, with some interbedded dark gray shale	2210	2220
26	Shale, dark gray, in part silty, with a little interbedded very fine-grained, light gray sandstone	2220	2246
	Top of Murrysville sand	2246	
10	Sandstone, very fine-grained, llght greenish-gray, containing a little muscovite	2246	2256

Thickness		Depth in feet Top	Bottom
24	Shale, dark gray, silty, with considerable interbedded very fine-grained, light gray sandstone, containing a little muscovite	2256	2280
12	Sandstone, very fine-grained, light gray, containing a little muscovite, with some interbedded dark gray silty shale	2280	2292
	Upper Devonian series, 525+ feet.		
	Conewango group, 525 feet.		
28	Shale, dark gray, with a little interbedded dark gray sandy and micaceous shale	2292	2320
60	Shale, dark gray, with a little interbedded greenish-gray, sandy shale and a little very fine-grained greenish-gray sandstone	2320	2380
20	Shale, gray to dark gray, with some interbedded greenish-gray silty shale, a little chocolate-brown silty shale and a very little coarse-grained, light gray sandstone containing quartz pebbles to 5 millimeters in diameter	2380	2400
10	Shale, gray to dark gray, with some interbedded greenish-gray silty shale and some fine to medium-grained, light gray sandstone	2400	2410
8	Shale, gray	2410	2418
	Top of Gantz sand	2418	
7	Sandstone, medium-grained, light gray	2418	2425
9	Shale, gray to dark gray, with some interbedded greenish-gray silty shale and a very little chocolate-brown silty shale	2425	2434
21	Sandstone, fine-grained, light gray, with an occasional quartz grain to 2 millimeters in diameter, with considerable interbedded gray, in part silty, shale—show of gas and oil at 2446	2434	2455
	Bottom of Gantz sand		2455
8	Shale, gray, in part silty, with considerable interbedded fine-grained, light gray sandstone containing occasional quartz pebbles to 8 millimeters in diameter	2455	2463
	Top of Fifty-foot sand	2463	
7	Sandstone, medium to coarse-grained, light gray	2463	2470
10	Sandstone, medium-grained, light gray, with some interbedded to dark gray shale	2470	2480
15	Sandstone, very fine-grained, light gray, containing a little muscovite, with a little interbedded gray shale	2480	2495
19	Sandstone, very fine to fine-grained, light gray, containing a little muscovite, with some interbedded gray shale	2495	2514
	Bottom of Fifty-foot sand		2514
16	Shale, gray, with some interbedded purplish-red, silty shale and some gray sandy shale	2514	2530
30	Shale, gray to dark gray, with a little interbedded very fine-grained, light gray sandstone	2530	2560
14	Shale, gray to dark gray, in part silty	2560	2574
1	Sandstone, fine to medium-grained, light gray	2574	2575
3	Shale, dark gray	2575	2578
8	Sandstone, fine-grained, light gray, containing a little muscovite, *Upper Nineveh*	2578	2586
12	Shale, purplish-red, in part silty, with some interbedded gray shale	2586	2598
8	Sandstone, very fine-grained, light gray to light greenish-gray, *Lower Nineveh*	2598	2606
4	Shale, brick-red, silty, with some interbedded gray shale	2606	2610
30	Shale, dark gray, with a little interbedded very fine-grained, light gray sandstone	2610	2640
10	Shale, gray to dark gray, with considerable interbedded dark gray silty shale containing a little muscovite	2640	2650
18	Shale, dark gray, with some interbedded very fine to fine-grained light gray sandstone and a little purplish-red silty shale	2650	2668
	Top of Gordon sand	2668	
22	Sandstone, fine-grained, light gray, with considerable interbedded gray shale	2668	2690
10	Sandstone, very fine-grained, light gray, with a great deal of interbedded gray shale	2690	2700
	Bottom of Gordon sand		2700
42	Shale, dark gray, with a little interbedded very fine-grained, light gray sandstone	2700	2742
6	Sandstone, very fine-grained, light gray, with a few quartz grains to 2 millimeters in diameter—*Fourth sand*	2742	2748
36	Shale, gray to dark gray	2748	2784
	Top of Fifth sand	2784	
6	Sandstone, fine-grained, light gray, with a few quartz grains to 2 millimeters in diameter	2784	2790
11	Sandstone, coarse-grained, light gray, with some interbedded gray shale	2790	2801
7	Sandstone, very fine-grained, light gray, with considerable interbedded gray shale	2801	2808
9	No samples	2808	2817
	Total depth		2817

Peoples Natural Gas Company,
No. 3632 Well, Mary W. Neill No. 1

North Strabane Township, Washington County, Pa.
Completed November 14, 1945. Elevation 1078 feet.

Thickness feet	*Description of strata, by Chas. R. Fettke*	*Depth in feet Top*	*Bottom*
	Pennsylvanian system, 1449+ feet.		
	Monongahela group, 338+ feet.		
55	No samples, water at 54 feet	0	55
18	Limestone, very fine, dense, light grayish to grayish-brown, argillaceous, *Waynesburg*	55	73
8	Shale, greenish-gray, micaceous and silty, containing some dark grayish-brown calcareous and ferruginous concretions	73	81
	Top of Uniontown sandstone	81	
16	Sandstone, very fine-grained, greenish-gray micaceous and slightly calcareous, containing a little interbedded gray to dark gray, silty and micaceous shale	81	97
6	Shale, dark gray, sandy and micaceous, containing fragments of carbonized plant remains, with some interbedded very fine-grained, light greenish-gray, micaceous and slightly calcareous sandstone	97	103
10	Sandstone, fine-grained, light gray, micaceous, containing fragments of carbonized plant remains, and a little pyrite	103	113
10	Sandstone, fine-grained, light gray, moderately friable, containing a little muscovite, somewhat calcareous	113	123
	Top of Uniontown limestone	123	
6	Limestone, very fine, dense, light brownish-gray, argillaceous, with considerable interbedded greenish-gray silty shale, containing some muscovite	123	129
6	Limestone, very fine, dense, light grayish-brown, argillaceous, with some interbedded very dark brownish-gray calcareous shale	129	135
25	Limestone, very fine, dense, light brownish-gray to dark grayish-brown, argillaceous	135	160
	Bottom of Uniontown limestone		160
3	Shale, dark greenish-gray, silty	160	163
5	Limestone, very dark brownish-gray, shaly	163	168
4	Shale, dark gray, somewhat calcareous	168	172
	Top of Benwood limestone	172	
23	Limestone, very fine, dense, light brownish-gray, argillaceous	172	195
5	Shale, brownish-gray, slightly calcareous	195	200
7	Limestone, very fine, dense, light brownish-gray, argillaceous, with some interbedded dark gray, slightly calcareous shale	200	207
17	Limestone, very fine, dense, light grayish to dark grayish-brown, argillaceous, with a little interbedded dark brownish-gray clay	207	224
	Bottom of Benwood limestone		224
8	Shale, very dark gray, silty, containing some muscovite, with a little interbedded fine-grained light gray, somewhat calcareous and micaceous sandstone	224	232
	Top of Fishpot limestone	232	
9	Limestone, very fine, dense, light to dark grayish-brown, argillaceous, with some interbedded dark to very dark gray slightly calcareous shale and a little brownish gray clay	232	241
9	Limestone, very fine, dense, light grayish-brown, argillaceous	241	250
	Bottom of Fishpot limestone		250
15	Clay, light gray, with considerable interbedded very fine, dense, light brownish-gray, argillaceous limestone	250	265
10	Clay, dark greenish-gray, somewhat calcareous,	265	275
20	Shale, greenish-gray, silty, containing some muscovite	275	295
1	Coal, Redstone	295	296
6	Clay, gray to dark gray, in part calcareous	296	302
5	Shale, dark to very dark gray	302	307
8	Shale, dark gray, silty, with some interbedded very fine-grained, light gray sandstone, containing some muscovite and minute fragments of carbonized plant remains	307	315
10	Shale, dark gray, silty, containing minute fragments of carbonized plant remains	315	325
6	Shale, dark gray, silty and sandy, containing some muscovite and a little pyrite	325	331
6	Coal, *Pittsburgh*	331	337
1	Clay, gray	337	338
	Conemaugh group, 632 feet.		
	Top of Pittsburgh limestone	338	
1	Limestone, very fine, dense, gray to dark gray, argillaceous	338	339
5	Siltstone, gray, containing some muscovite	339	344

Thickness		Depth in feet Top	Bottom
5	Limestone, very fine, dense, light brownish-gray, argillaceous	344	349
	Bottom of Pittsburgh limestone		349
28	Clay, light to dark gray, with some interbedded very fine, dense, brownish-gray limestone and light gray siltstone—10-inch casing set at 370.3 feet	349	377
10	Sandstone, very fine-grained, light gray, somewhat micaceous, *Connellsville*	377	387
18	Shale, greenish-gray, silty	387	405
9	Shale, greenish-gray, sandy	405	414
4	Clay, variegated, yellowish brown to brick red	414	418
26	Shale, greenish-gray, silty and sandy, micaceous	418	444
13	Shale, greenish-gray, silty, with considerable interbedded very fine, dense, light grayish-brown argillaceous limestone and a little gray and brick-red clay	444	457
	Top of Clarksburg clay	457	
14	Clay, variegated, gray to red, in part calcareous, with a little interbedded very fine, dense, light brownish-gray, argillaceous limestone	457	471
12	Clay, brownish and purplish-red, in part calcareous	471	483
4	Shale, brick-red, silty	483	487
	Bottom of Clarksburg clay		487
9	Shale, greenish-gray, silty	487	496
6	Shale, greenish-gray, sandy, micaceous	496	502
	Top of Morgantown sandstone, Murphy sand	502	
12	Sandstone, fine-grained, light greenish-gray, containing some muscovite	502	514
6	Sandstone, medium-grained, light greenish-gray, containing some muscovite	514	520
	Top of Wellersburg clay	520	
5	Clay, variegated, light greenish-gray to purplish red, in part calcareous	520	525
26	Clay, brick-red, somewhat calcareous, with some interbedded greenish-gray silty shale	525	551
11	Shale, brick-red, silty	551	562
	Top of Birmingham shale	562	
16	Shale, greenish-gray, silty, containing some muscovite, with some interbedded very fine-grained, light greenish-gray, micaceous sandstone	562	578
19	Shale, dark greenish-gray, silty, with some interbedded olive-gray, calcareous shale	578	597
	Top of Pittsburgh red beds	597	
8	Clay, gray, calcareous	597	605
3	Limestone, very fine, dense, light gray, containing fragments of minute crinoid stems—*Ames*	605	608
16	Clay, light greenish-gray to gray, calcareous	608	624
15	Clay, variegated, greenish-gray to purplish-red, slightly calcareous, containing some calcareous concretions	624	639
18	Shale, greenish-gray, silty, with some interbedded variegated, slightly calcareous clay	639	657
	Bottom of Pittsburgh red beds		657
17	Shale, greenish-gray, silty, containing some muscovite	657	674
11	Shale, dark gray, silty	674	685
31	Shale, dark gray, sandy, somewhat micaceous, containing minute fragments of carbonized plant remains	685	716
13	Shale, greenish-gray, silty, containing some interbedded, light gray clay	716	729
20	Shale, greenish-gray, silty	729	749
3	Shale, dark gray	749	752
	Top of Saltsburg sandstone	752	
5	Sandstone, very fine-grained, light greenish-gray	752	757
4	Shale, greenish-gray, silty	757	761
7	Sandstone, very fine-grained, light greenish-gray	761	768
	Bottom of Saltsburg sandstone		768
56	Shale, dark gray, silty, containing an occasional shell fragment	720	824
2	Limestone, very fine, dense, dark gray, containing minute fragments of shells	824	826
37	Shale, dark gray, silty	826	863
1	Coal, *Brush Creek*	863	864
20	Clay, dark brownish-gray	864	884
5	Clay, greenish-gray to gray	884	889
16	Shale, greenish-gray, silty, with some interbedded gray clay	889	905
4	Shale, greenish-gray	905	909
15	Siltstone, greenish-gray, with considerable interbedded light gray clay and some very fine, dense, light brownish-gray limestone	909	924
18	Shale, greenish-gray, sandy	924	942
	Top of Mahoning sandstone, Big Dunkard	942	
8	Sandstone, very fine-grained, light greenish-gray, containing a little muscovite	942	950
12	Sandstone, fine-grained, light gray	950	962
8	Sandstone, coarse-grained, light gray	962	970

Thickness		Depth in feet Top	Bottom
	Allegheny group, restricted, 171 feet.		
11	Clay, light gray to gray, with a little interbedded very fine-grained, light gray sandstone containing minute siderite pellets	970	981
5	Shale, gray, with some interbedded light gray siltstone	981	986
12	Shale, gray, silty and sandy	986	998
21	Shale, dark gray, silty, containing some fragments of carbonized plant remains	998	1019
	Top of Butler sandstone	1019	
5	Sandstone, very fine to fine-grained, light gray	1019	1024
3	Sandstone, fine to medium-grained, light gray	1024	1027
	Bottom of Butler sandstone		1027
1	Shale, very dark gray, silty, containing carbonized fragments of plants	1027	1028
1	Coal, Lower Freeport	1028	1029
1	Clay, light gray	1029	1030
2	Limestone, very fine, dense, gray to dark gray, argillaceous	1030	1032
4	Sandstone, very fine-grained, light gray, containing some muscovite	1032	1036
10	Shale, dark to very dark gray, in part silty	1036	1046
5	Shale, light gray to gray, silty	1046	1051
8	Sandstone, very fine-grained, light gray, containing a little muscovite, *Freeport*	1051	1059
23	Shale, dark gray, silty, containing some muscovite and minute fragments of carbonized plant remains	1059	1082
8	Shale, dark gray, with considerable interbedded light gray silty and sandy clay	1082	1090
14	Shale, dark gray, silty	1090	1104
1	Shale, grayish-black	1104	1105
24	Shale, dark gray, silty, containing a few fragments of carbonized plant remains	1105	1129
3	Sandstone, fine-grained, light gray	1129	1132
5	Shale, dark gray	1132	1137
4	Shale, black, with some interbedded coal, *Lower Kittanning*	1137	1141
	Upper Pottsville—Kanawha series, 308 feet.		
6	Siltstone, light gray, containing minute brown siderite pellets	1141	1147
24	Shale, gray, silty, with a little interbedded light gray siltstone	1147	1171
	Top of Kittanning sandstone, First Gas sand	1171	
4	Sandstone, very fine-grained, light gray, slightly calcareous	1171	1175
5	Shale, dark gray, silty	1175	1180
11	Sandstone, very fine-grained, light gray, with considerable interbedded dark gray silty shale containing some minute fragments of carbonized plant remains	1180	1191
	Bottom of Kittanning sandstone		1191
16	Shale, dark gray, in part silty	1191	1207
15	Shale, dark to very dark gray	1207	1222
4	Shale, dark gray, silty	1222	1226
5	Claystone, light brownish-gray	1226	1231
11	Shale, dark gray, silty	1231	1242
15	Shale, dark gray, silty, with some interbedded very fine-grained, gray sandstone containing some muscovite—8 M. C. F. gas at 1243 feet	1242	1257
6	Shale, dark gray, sandy	1257	1263
	Top of Homewood sandstone, First Salt Sand	1263	
9	Sandstone, fine-grained, light gray, containiug fragments of carbonized plant remains, with considerable interbedded dark gray, silty shale	1263	1272
49	Sandstone, medium-grained, light gray—salt water at 1282 feet and 1318 feet	1272	1321
3	Sandstone, medium to coarse-grained, light gray	1321	1324
	Bottom of Homewood sandstone		1324
6	Shale, dark gray, silty	1324	1330
5	Shale, dark gray, with considerable interbedded, light buff-gray siltstone, containing a little muscovite	1330	1335
29	Shale, dark gray, silty and sandy	1335	1364
25	Shale, dark gray	1364	1389
6	Siltstone, buff-gray	1389	1395
	Top of Upper Connoquenessing sandstone, Second Salt sand	1395	
6	Sandstone, coarse-grained, light gray—salt water and show of gas at 1401 feet	1395	1401
8	Sandstone, medium-grained, light gray, almost white, containing a little muscovite	1401	1409
11	Sandstone, fine-grained, light gray, containing a little muscovite	1409	1420
	Bottom of Upper Connoquenessing sandstone		1420
10	Shale, dark gray, silty, with some interbedded light buff siltstone	1420	1430

Thickness		Depth in feet Top	Bottom
9	Sandstone, very fine-grained, light gray, containing a little muscovite and occasional fragment of carbonized plant remains, *Lower Connoquenessing Maxton*	1430	1439
2	Shale, very dark gray to grayish-black, containing some muscovite	1439	1441
8	Shale, brownish to dark brownish-gray, silty, containing some muscovite	1441	1449
	Mississippian system, 602 feet.		
	Greenbrier group, 71 feet.		
26	Limestone, very fine, dense, grayish to dark grayish-brown, somewhat argillaceous, containing fragments of shells	1449	1475
45	Limestone, very fine to fine, light brownish and greenish-gray, sandy, with sand grains very fine to fine and subangular, a few rounded and frosted—*Loyalhanna.* 8¼-inch casing set at 1480.25 feet	1475	1520
	Pocono group, 531 feet.		
	Top of Big Injun sand	1520	
22	Sandstone, very fine-grained, light greenish-gray, slightly calcareous, containing a little muscovite	1520	1542
4	Shale, gray, silty	1542	1546
6	Sandstone, fine-grained, light gray	1546	1552
61	Sandstone, fine to medium-grained, light gray, almost white, moderately friable, containing a little muscovite—Show of gas at 1554 feet	1552	1613
48	Sandstone, fine-grained, light gray, almost white, moderately hard, containing a little muscovite and occasional fragments of carbonized plant remains	1613	1661
14	Shale, gray, sandy, containing some muscovite and minute fragments of carbonized plant remains, with a great deal of interbedded fine-grained, light gray sandstone, containing a little muscovite	1661	1675
5	Shale, gray, silty	1675	1680
20	Sandstone, very fine-grained, light gray, containing a little muscovite and occasional minute fragments of carbonized plant remains, with a little interbedded gray, silty shale	1680	1700
	Bottom of Big Injun sand		1700
8	Shale, gray, silty	1700	1708
6	Shale, gray, with some interbedded very fine-grained, light gray, slightly calcareous sandstone	1708	1714
45	Shale, gray in part sandy	1714	1759
	Top of Squaw sand	1759	
5	Sandstone, very fine-grained, light greenish-gray, moderately hard and slightly calcareous, with a great deal of interbedded gray shale	1759	1764
10	Sandstone, very fine-grained, light greenish-gray, containing a little muscovite, with a little interbedded gray shale	1764	1774
19	Shale, gray	1774	1793
17	Shale, gray to dark gray, silty, with some interbedded light greenish-gray to gray siltstone	1793	1810
12	Sandstone, very fine-grained, light greenish-gray, moderately hard, containing a little muscovite, with considerable interbedded dark gray, in part, silty shale	1810	1822
12	Sandstone, very fine-grained, light greenish-gray, containing a little muscovite, with a little interbedded gray shale	1822	1834
	Bottom of Squaw sand		1834
33	Shale, dark gray, with a little interbedded very fine-grained, light gray sandstone	1834	1867
16	Shale, dark gray	1867	1883
34	Shale, dark gray, with a little interbedded greenish-gray siltstone	1883	1917
13	Siltstone, dark greenish-gray, containing a little muscovite, with considerable interbedded dark gray shale	1917	1930
8	Sandstone, fine-grained, light gray, containing a little muscovite, with considerable interbedded gray shale, *Second Gas sand*	1930	1938
18	Shale, greenish-gray, silty, with considerable interbedded dark gray shale	1938	1956
40	Shale, dark gray, in part silty, containing some minute fragments of carbonized plant remains	1956	1996
	Top of Murrysville sand	1996	
12	Sandstone, very fine-grained, light gray, moderately hard and somewhat calcareous, containing a little muscovite, with some interbedded dark gray, in part silty shale	1996	2008
13	Siltstone, light greenish-gray, containing a little muscovite and occasional minute fragments of carbonized plant remains, with a great deal of interbedded dark gray, in part silty, shale	2008	2021
6	Shale, gray	2021	2027

Thickness		Depth in feet Top	Bottom
12	Sandstone, very fine-grained, light gray, containing a little muscovite, with some interbedded gray to dark gray shale, in party silty	2027	2039
7	Siltstone, light gray, containing a little muscovite, with considerable interbedded dark gray shale	2039	2046
5	Sandstone, very fine-grained, light gray, containing a little muscovite, with a little interbedded gray silty shale	2046	2051
	Upper Devonian series, 633+ feet.		
	Conewango group, 518 feet.		
24	Shale, gray to dark gray, with considerable interbedded light greenish-gray siltstone, containing a little muscovite	2051	2075
30	Shale, gray to dark gray, with a little interbedded light gray to greenish-gray siltstone	2075	2105
44	Shale, gray to dark gray, in part silty	2105	2149
7	Shale, dark greenish-gray, silty, containing some muscovite, with a little interbedded dark gray shale	2149	2156
14	Shale, dark chocolate-brown to purplish-gray, in part silty, with some interbedded dark greenish-gray silty shale and some dark gray shale	2156	2170
	Top of Gantz sand	2170	
1	Sandstone, coarse-grained, light gray, containing some rounded quartz pebbles to 5 millimeters in diameter	2170	2171
9	Shale, gray, with considerable interbedded very fine-grained, lightly gray sandstone	2171	2180
8	Sandstone, very fine-grained, light gray, with a little interbedded gray shale	2180	2188
12	Sandstone, very fine to fine-grained, light gray, with a few rounded quartz pebbles to 4 millimeters in diameter, with a little interbedded gray silty shale	2188	2200
12	Sandstone, coarse-grained, light gray, moderately hard—12 MCF gas—show of oil and salt water at 2203 feet	2200	2212
8	Sandstone, very fine to fine-grained, light gray, with an occasional flat quartz pebble to 1 centimeter in diameter, with a little interbedded gray, silty shale	2212	2220
1	Sandstone, coarse-grained, light gray	2220	2221
5	Sandstone, very fine to fine-grained, light gray	2221	2226
1	Shale, gray	2226	2227
2	Sandstone, coarse-grained, light gray	2227	2229
4	Sandstone, very fine to fine-grained, light gray	2229	2233
3	Sandstone, coarse-grained, light gray	2233	2236
	Bottom of Gantz sand		2236
14	Shale, gray, in party silty	2236	2250
12	Shale, gray, in part silty, with a little interbedded very fine-grained, light gray sandstone	2250	2262
	Top of Fifty-foot sand	2262	
14	Sandstone, very fine to fine-grained, light gray, with some interbedded purplish red shale and a little gray silty shale	2262	2276
13	Sandstone, fine to medium-grained, light gray, containing a little muscovite	2276	2289
	Bottom of Fifty-foot sand		2289
15	Shale, dark gray, with considerable interbedded greenish-gray silty shale and a little very fine-grained, light greenish-gray sandstone—6⅝-inch casing set at 2297.75 feet	2289	2304
30	Shale, dark gray	2304	2334
9	Shale, dark gray, with considerable interbedded very fine-grained, light greenish-gray sandstone	2334	2343
6	Sandstone, very fine-grained, light gray, with considerable interbedded dark gray shale and a little dark purplish-gray silty shale, *Upper Nineveh*	2343	2349
4	Shale, dark gray, with considerable interbedded dark purplish-gray silty shale	2349	2353
10	Shale, dark purplish-red, silty, with some interbedded dark gray shale and a little greenish-gray siltstone	2353	2363
	Top of Lower Nineveh sand	2363	
6	Sandstone, very fine-grained, light gray, slightly calcareous and containing a little muscovite, with considerable interbedded dark gray shale	2363	2369
4	Sandstone, very fine-grained, light gray, moderately hard, slightly calcareous and containing a little muscovite	2369	2373
	Bottom of Lower Nineveh sand		2373
32	Shale, gray to dark gray	2373	2405
6	Shale, dark gray, with some interbedded greenish-gray siltstone	2405	2411
5	Shale, dark gray, with considerable interbedded, very fine-grained, light greenish-gray sandstone containing a few rounded quartz grains to 1 millimeter in diameter	2411	2416
13	Shale, greenish-gray, sandy, with some interbedded brick-red silty shale and some dark gray shale	2416	2429

Thickness		Depth in feet Top	Bottom
5	Shale, dark gray, with considerable interbedded very fine-grained, light greenish-gray sandstone, containing a few quartz grains to 1 millimeter in diameter	2429	2434
	Top of Gordon sand	2434	
6	Sandstone, very fine-grained, light gray, in part slightly calcareous, with some interbedded dark gray shale	2434	2440
7	Sandstone, coarse-grained, light gray, slightly calcareous, with considerable interbedded greenish-gray, silty and sandy shale	2440	2447
4	Sandstone, coarse, conglomeritic, light gray, with considerable interbedded gray to dark gray shale—38 MCF gas and show of oil at 2449 feet, shot 2447 to 2457 feet, very little increase in gas	2447	2451
8	Sandstone, medium-grained, light gray, moderately hard	2451	2459
8	Sandstone, very fine to fine-grained, light gray, with some interbedded gray to dark gray shale	2459	2467
	Bottom of Gordon sand		2467
9	Shale, dark gray, with a little interbedded very fine-grained, light gray sandstone	2467	2476
6	Shale, dark gray	2476	2482
5	Shale, greenish-gray, silty	2482	2487
18	Shale, dark gray, in part silty, with some interbedded very fine-grained, light gray to gray sandstone	2487	2505
10	Sandstone, very fine-grained, light greenish-gray, with some interbedded gray shale—*Fourth sand*	2505	2515
28	Shale, gray to dark gray, with a little interbedded very fine-grained, greenish gray sandstone	2515	2543
	Top of Fifth sand	2543	
7	Sandstone, very fine-grained, light gray, with an occasional quartz pebble to 5 millimeters in diameter, with a little interbedded gray shale	2543	2550
12	Sandstone, coarse, conglomeritic, light gray, with some interbedded gray shale	2550	2562
7	Sandstone, very fine-grained, light gray, with a few quartz grains to 4 millimeters in diameter, with considerable interbedded gray shale	2562	2569
	Bottom of Fifth sand		2569
	Conneaut group, 115+ feet.		
106	Shale, dark gray, in part silty	2569	2675
4	Siltstone, dark grayish-brown, containing a few quartz grains to 1 millimeter in diameter	2675	2679
5	Shale, dark gray	2679	2684
	Total depth		2684

Peoples Natural Gas Company, No. 3299 Well, Wallace Hamilton et ux No. 1

North Strabane Township, Washington County, Pa.
Completed September 12, 1941. Elevation, 1172 feet.

Thickness feet	Description of strata, by Chas. R. Fettke	Depth in feet Top	Bottom
	Permian System		
	Washington group, 117+ feet.		
17	No samples	0	17
10	Clay, gray, somewhat calcareous, with some interbedded very fine, dense, brownish-gray argillaceous limestone, in part stained yellowish-brown by weathering	17	27
20	Shale, light gray, sandy and micaceous	27	47
3	Coal, containing some pyrite, *Waynesburg A*	47	50
7	Claystone, light gray, somewhat calcareous	50	57
7	Sandstone, very fine-grained, light gray, somewhat micaceous, *Waynesburg*	57	64
9	Shale, light gray, silty, containing some muscovite	64	73
20	Shale, gray, in part silty, containing some yellowish-brown calcareous concretions	73	93
5	Clay, gray, slightly calcareous, containing some grayish-brown calcareous concretions	93	98
1	Coal	98	99
17	Shale, dark gray, silty and sandy, micaceous, containing minute fragments of carbonized plant remains, *Cassville*	99	116
1	Shale, grayish-black	116	117
	Pennsylvanian system, 1433 feet.		
	Monongahela group, 289 feet.		
1	Coal, Waynesburg	117	118
6	Shale, very dark gray to grayish-black, silty, with a little interbedded very fine-grained, light gray, somewhat micaceous sandstone	118	124

Thickness		Depth in feet Top	Bottom
6	Shale, dark gray, with some interbedded light gray siltstone	124	130
	Top of Waynesburg limestone	130	
5	Limestone, very fine, dense, grayish-brown, somewhat argillaceous and magnesian, containing abundant light brownish-gray vitreous chert	130	135
5	Claystone, light gray, calcareous	135	140
17	Limestone, very fine, dense, light brownish to dark brownish-gray, with some interbedded gray clay	140	157
	Bottom of Waynesburg limestone		157
1	Shale, grayish-black	157	158
1	Coal, Uniontown	158	159
	Top of Uniontown limestone	159	
12	Limestone, very fine, dense, light brownish-gray, argillaceous, with a little interbedded gray clay	159	171
19	Limestone, very fine, dense, light brown to brownish-gray, argillaceous, with some interbedded gray silty shale	171	190
5	Shale, greenish gray, silty, containing some muscovite	190	195
23	Limestone, very fine, dense, light brownish-gray, argillaceous and somewhat magnesian, with some interbedded light gray calcareous clay	195	218
	Bottom of Uniontown limestone		218
4	Shale, greenish-gray, silty	218	222
9	Shale, dark gray, calcareous	222	231
52	Limestone, very fine, dense, light to dark brownish-gray, argillaceous, with a little interbedded gray clay, *Benwood*	231	283
16	Shale, dark gray, silty and micaceous, containing some minute fragments of carbonized plant remains and pyrite	283	299
20	Limestone, very fine, dense, light brownish to brownish-gray, argillaceous, with a little interbedded gray clay, *Fishpot*	299	319
13	Clay, light to dark greenish-gray, in part calcareous	319	332
2	Clay, brick-red, somewhat calcareous	332	334
13	Shale, gray, silty, and micaceous	334	347
10	Shale, very dark gray, in part silty, with some interbedded very fine-grained, light gray sandstone	347	357
1	Coal, Redstone	357	358
26	Shale, very dark gray, silty, sandy, and micaceous, containing some minute fragments of carbonized plant remains	358	384
9	Shale, dark gray, in part silty and micaceous	384	393
3	Shale, grayish-black	393	396
8	Coal, with some interbedded very dark gray shale, Pittsburgh, 25 M. C. F. gas at 400 feet, water at 404 feet	396	404
2	Clay, dark gray, containing some dark brownish-gray calcareous concretions	404	406
	Conemaugh group, 623 feet.		
4	Shale, light gray, sandy and micaceous	406	410
	Top of Pittsburgh limestone	410	
5	Limestone, very fine, dense, grayish-brown, argillaceous, with some interbedded very dark gray shale, in part silty	410	415
6	Shale, light gray, silty	415	421
13	Limestone, very fine, dense, light brownish-gray, argillaceous, containing an occasional shell fragment, with some interbedded gray clay	421	434
	Bottom of Pittsburgh limestone		434
12	Clay, gray, with considerable interbedded very fine, dense, brownish-gray, argillaceous limestone and some light gray silty shale	434	446
	Top of Connellsville sandstone	446	
13	Sandstone, very fine to fine, light gray, somewhat micaceous, 10-inch casing set at 447.6 feet	446	459
6	Shale, gray, silty	459	465
4	Sandstone, fine-grained, light gray, somewhat micaceous	465	469
	Bottom of Connellsville sandstone		469
24	Shale, gray to dark gray	469	493
23	Shale, dark gray, sandy and micaceous, containing minute fragments of carbonized plant remains	493	516
	Top of Clarksburg clay	516	
19	Clay, variegated, light greenish-gray to purplish-red, with a little interbedded very fine, dense, light brownish-gray, argillaceous limestone	516	535
7	Clay, brick-red, somewhat calcareous	535	542
	Bottom of Clarksburg clay		542
39	Shale, grayish-green, silty, with a little interbedded brick-red, silty shale	542	581
8	Clay, variegated, gray to brick-red, somewhat calcareous, Wellersburg	581	589
	Top of Birmingham shale	589	
37	Shale, grayish-green, silty	589	626
8	Shale, gray to very dark gray	626	634
	Bottom of Birmingham shale		634

Thickness		*Depth in feet* Top	Bottom
1	Coal, Duquesne	634	635
5	Clay, gray, somewhat calcareous	635	640
	Top of Pittsburgh red beds	640	
11	Clay, variegated, light greenish-gray to purplish-red, calcareous	640	651
4	Shale brick-red, silty	651	655
5	Shale, greenish-gray, silty	655	660
9	Shale, purplish-red, silty, with some interbedded variegated, somewhat calcareous clay	660	669
4	Limestone, very fine, dense, light brownish-gray, containing abundant fragments of brachiopod shells, *Ames*	669	673
12	Clay, greenish-gray, slightly calcareous	673	685
21	Clay, variegated, greenish-gray to purplish-red, somewhat calcareous	685	706
	Bottom of Pittsburgh red beds		706
20	Shale, greenish-gray, silty and sandy, containing some muscovite	706	726
10	Shale, greenish-gray, with some interbedded reddish-brown shale	726	736
18	Shale, dark gray, silty	736	754
3	Clay, light greenish-gray, with a little interbedded very fine, dense, light gray limestone	754	757
24	Shale, greenish-gray, silty and sandy	757	781
54	Shale, greenish-gray, silty	781	835
22	Shale, drak gray, sandy and somewhat micaceous	835	855
27	Shale, dark gray, silty, and somewhat micaceous, containing minute fragments of carbonized plant remains and a little pyrite	855	882
17	Shale, dark gray	882	899
11	Clay, gray to dark gray	899	910
12	Clay, variegated, gray to purplish-red, with some interbedded greenish-gray, silty shale	910	922
28	Shale, greenish-gray, silty, with considerable interbedded variegated, gray to purplish-red, slightly calcareous clay	922	950
6	Siltstone, light gray	950	956
23	Clay, variegated, light gray to purplish-red, in part somewhat calcareous	956	979
6	Shale, gray, silty	979	985
	Top of Mahoning sandstone, *Big Dunkard*	985	
7	Sandstone, very fine-grained, light gray, with some interbedded gray, sandy shale	985	992
6	Sandstone, very fine-grained, light gray, almost white, containing a little muscovite	992	998
5	Sandstone, fine-grained, light gray, almost white, moderately friable, with a little interbedded gray silty shale	998	1003
6	Sandstone, fine-grained, light gray	1003	1009
20	Sandstone, medium-grained, light gray, almost white, with a little interbedded gray to dark gray silty shale	1009	1029
	Allegheny group, restricted, 179 feet.		
1	Coal, Upper Freeport	1029	1030
6	Sandstone, medium-grained, light gray, almost white	1030	1036
17	Shale, gray to dark gray, in part silty	1036	1053
14	Shale, dark gray, in part silty, with considerable interbedded gray to dark gray, sandy and somewhat micaceous shale, containing minute fragments of carbonized plant remains	1053	1067
1	Coal, Lower Freeport	1067	1068
1	Clay, gray	1068	1069
31	Shale, light gray to gray, silty	1069	1100
12	Shale, dark gray, silty	1100	1112
12	Shale, dark gray, silty, with considerable interbedded very fine-grained, light gray sandstone containing some muscovite and a few carbonized plant remains	1112	1124
	Top of Freeport sandstone	1124	
6	Sandstone, very fine-grained, light gray, moderately friable, containing a few carbonized plant remains	1124	1130
15	Sandstone, very fine-grained, light gray, moderately friable, with a great deal of interbedded dark to very dark gray silty shale	1130	1145
	Bottom of Freeport sandstone		1145
1	Coal, Upper Kittanning	1145	1146
1	Clay, gray	1146	1147
6	Shale, dark gray	1147	1153
5	Siltstone, light gray, containing minute siderite pellets,	1153	1158
24	Shale, dark gray, silty	1158	1182
10	Shale, dark gray, silty, with some interbedded, very fine-grained, light gray sandstone	1182	1192
5	Sandstone, fine-grained, light gray	1192	1197
6	Shale, dark gray, silty, with some interbedded dark gray sandy shale containing minute fragments of carbonized plant remains	1197	1203

Thickness		Depth in feet Top	Bottom
3	Shale, dark to very dark gray	1203	1206
1	Coal, Lower Kittanning	1206	1207
1	Clay, light to dark gray	1207	1208
	Upper Pottsville-Kanawha series 342 feet.		
8	Shale, dark gray, silty, with considerable interbedded light gray siltstone	1208	1216
12	Shale, light gray to gray, silty and sandy	1216	1228
14	Shale, gray to dark gray, silty	1228	1242
10	Shale, dark gray, silty, with a little interbedded fine-grained, light gray sandstone	1242	1252
17	Shale, dark gray, in part silty	1252	1269
20	Shale, dark gray	1269	1289
7	Shale, light gray, sandy and micaceous	1289	1296
4	Shale, gray, silty and somewhat micaceous	1296	1300
	Top of Homewood sandstone, *First Salt sand*	1300	
18	Sandstone, fine-grained, light gray, slightly calcareous and somewhat micaceous	1300	1318
12	Sandstone, fine-grained, light gray, slightly calcareous and somewhat micaceous, with a little interbedded dark gray silty shale	1318	1330
25	Sandstone, medium-grained, light gray, moderately friable, containing a little muscovite	1330	1355
21	Sandstone, medium-grained, light gray, moderately friable, with a little interbedded dark gray silty shale, containing minute fragments of carbonized plant remains	1355	1376
7	Sandstone, medium-grained, light gray, containing a little muscovite	1376	1383
	Bottom of Homewood sandstone		1383
4	Shale, dark gray, silty	1383	1387
2	Shale, grayish black	1387	1389
1	Coal, Mercer	1389	1390
35	Shale, very dark gray, with a little interbedded dark gray silty shale, containing fragments of carbonized plant remains	1390	1425
2	Shale, grayish black, silty and sandy	1425	1427
7	Shale, dark gray, silty and sandy, containing some muscovite and minute fragments of carbonized plant remains	1427	1434
	Top of Upper Connoquenessing sandstone, Second Salt sand	1434	
6	Sandstone, fine-grained, light gray, somewhat micaceous, containing fragments of carbonized plant remains	1434	1440
22	Sandstone, very fine-grained, light gray, moderately hard, containing some muscovite and minute fragments of carbonized plant remains with a little interbedded dark gray silty shale	1440	1462
	Bottom of Upper Conoquenessing sandstone		1462
2	Shale, dark gray, silty, containing minute fragments of carbonized plant remains	1462	1464
2	Shale, grayish-black	1464	1466
1	Coal, containing considerable pyrite,	1466	1467
1	Shale, grayish-black	1467	1468
5	Shale, dark gray, silty, with some interbedded light brownish-gray siltstone	1468	1473
25	Shale, dark gray	1473	1498
4	Shale, dark gray, sandy, containing some muscovite and minute fragments of carbonized plant remains	1498	1502
	Top of Lower Connequenessing sandstone—Maxton sand	1502	
8	Sandstone, very fine to fine-grained, light gray, with considerable interbedded dark gray silty shale, containing minute fragments of carbonized plant remains	1502	1510
6	Sandstone, fine-grained, light gray, moderately hard, containing a little muscovite with some interbedded very dark gray shale	1510	1516
11	Sandstone, fine-grained, very light gray, moderately hard, containing a little muscovite. 8¼-inch casing set at 1524 feet	1516	1527
9	Sandstone, medium-grained, very light gray, moderately hard, containing a little muscovite and a few fragments of carbonized plant remains. 42 M.C.F. gas in Maxton sand	1527	1536
	Bottom of Lower Connoquenessing sandstone		1536
14	Shale, very dark gray, silty	1536	1550
	Mississippian system, 584 feet.		
	Loyalhanna limestone, 57 feet.		
41	Limestone, very fine to fine, very light brownish-gray, sandy; larger quartz grains rounded and frosted	1550	1591
16	Limestone, very fine to fine, very light greenish-gray, sandy; larger quartz grains rounded and frosted	1591	1607

Thickness		Depth in feet Top	Bottom
	Pocono group, 527 feet.		
	Top of Big Injun sand	1607	
11	Sandstone, very fine-grained, very light greenish-gray, slightly calcareous and containing a little muscovite	1607	1618
18	Sandstone, very fine to fine-grained, light greenish-gray, containing a little muscovite, with some interhedded dark gray shale	1618	1636
14	Sandstone, very fine to fine-grained, light greenish-gray, containing a little muscovite	1636	1650
18	Sandstone, very fine to fine-grained, light greenish-gray, somewhat micaceous	1650	1668
11	Sandstone, fine-grained, light greenish-gray, containing a little muscovite	1668	1679
15	Sandstone, medium-grained, light gray, containing a little muscovite	1679	1694
31	Sandstone, fine-grained, light greenish-gray, containing a little muscovite	1694	1725
29	Sandstone, fine-grained, light greenish-gray, containing a little muscovite and some fragments of carbonized plant remains, with a little interbedded greenish-gray silty shale	1725	1754
28	Shale, dark greenish-gray, silty, with a little interbedded fine-grained, light gray sandstone	1754	1782
11	Sandstone, fine-grained, light gray, containing a little muscovite, with considerable interhedded dark greenish-gray silty shale	1782	1793
	Bottom of Big Injun sand		1793
17	Shale, dark gray	1793	1810
31	Shale, dark gray, with considerable interbedded greenish-gray siltstone	1810	1841
18	Shale, dark gray, with considerahle interbedded very fine-grained, light greenish-gray sandstone	1841	1859
16	Shale, dark to very dark gray, with a little interhedded very fine to fine-grained, light gray sandstone	1859	1875
	Top of Squaw sand	1875	
5	Sandstone, very fine-grained, light greenish-gray, with considerahle interbedded dark gray shale	1875	1880
15	Shale, dark gray, with some interhedded very fine-grained, light greenish-gray sandstone	1880	1895
10	Shale, dark gray, with considerable interhedded very fine-grained, light gray sandstone	1895	1905
	Bottom of Squaw sand		1905
78	Shale, gray to dark gray	1905	1983
27	Shale, dark gray, with a little interbedded gray siltstone	1983	2010
17	Sandstone, very fine-grained, light greenish to greenish-gray, containing some muscovite, with a great deal of interbedded dark gray shale, *Second Gas sand*	2010	2027
17	Shale, dark gray, silty	2027	2044
9	Siltstone, greenish-gray, containing some muscovite, with a great deal of interbedded dark gray shale	2044	2053
13	Shale, gray, silty, with some interhedded dark gray shale	2053	2066
26	Shale, dark gray, with considerahle interhedded greenish-gray siltstone containing some muscovite	2066	2092
	Top of Murrysville sand	2092	
5	Sandstone, very fine-grained, light greenish-gray, containing some muscovite, with considerahle interbedded dark gray shale	2092	2097
24	Shale, dark gray, with some interbedded very fine-grained, light gray sandstone, containing some muscovite	2097	2121
9	Sandstone, very fine-grained, light greenish-gray, containing some muscovite, with considerable interhedded dark gray shale, in part silty	2121	2130
4	Sandstone, very fine-grained, light greenish-gray, containing a little muscovite, with a little interbedded gray to dark gray shale	2130	2134
	Bottom of Murrysville sand		2134
	Upper Devonian series.		
	Conewango group, 511 feet.		
14	Shale, gray	2134	2148
8	Shale, dark gray, with a little interbedded light greenish-gray, slightly calcareous siltstone	2148	2156
34	Shale, gray to dark gray, in part silty	2156	2190
52	Shale, gray to dark gray, with a little interbedded greenish-gray siltstone	2190	2242
12	Shale, gray to dark gray, with a little interbedded dark purplish-gray silty shale	2242	2254
	Top of Gantz sand	2254	
1	Sandstone, medium to coarse-grained, light gray	2254	2255
6	Sandstone, very fine-grained, light gray, containing a few rounded milky quartz grains to 3 millimeters in diameter, with much interbedded dark gray shale	2255	2261

Thickness		Depth in feet Top	Bottom
8	Sandstone, very fine to fine-grained, light gray, containing some quartz grains to 4 millimeters in diameter, witb a llttle interbedded gray sbalo	2261	2269
4	Sandstone, fine to coarse-grained, llght gray, pebbly, with some quartz grains to 3 millimeters in diameter	2269	2273
15	Sandstone, fine to medium-grained, light gray, pebbly, with some quartz grains to 4 millimeters in diameter	2273	2288
	Bottom of Gantz sand		2288
9	Shale, dark gray, silty, with some interbedded fine to medium-grained. light gray, pebbly sandstone, with some quartz grains to 4 millimeters in diameter	2288	2297
	Top of Fifty-foot sand	2297	
8	Sandstone, coarse-grained, light gray, contalning some rounded milky quartz grains to 3 milllmeters in diameter, with some interbedded gray shale—113 M.C.F. gas at 2297 feet	2297	2305
11	Sandstone, very fine to fine-grained, light gray, containing some rounded milky quartz grains to 4 millimeters in diameter, wlth considerable interbedded gray to dark gray shale	2305	2316
6	Shale, dark gray, with some interbedded greenish-gray silty shale	2316	2322
8	Sandstone, very fine-grained, light gray, with a great deal of interbedded gray to dark gray shale	2322	2330
17	Sandstone, very fine-grained, light greenish-gray, moderately hard, with some interbedded gray to dark gray shale	2330	2347
	Bottom of Fifty-foot sand		2347
6	Shale, dark reddish-brown, silty	2347	2353
17	Shale, dark gray, with a little interbedded very fine-grained, light gray sandstone	2353	2370
26	Shale, dark gray, with some interbedded very fine-grained, light gray sandstone, containing a little muscovite	2370	2396
11	Shale, dark gray, with considerable interbedded very fine to fine-grained, light gray sandstone	2396	2407
23	Sandstone, very fine-grained, light gray to light greenish-gray, with a great deal of interbedded gray shale, *Upper Nineveh*	2407	2430
5	Shale, dark reddish-brown, in part silty, with considerable interbedded gray to dark gray shale	2430	2435
15	Sandstone, very fine-grained, light greenish-gray, with considerable interbedded dark reddish-brown silty shale and some dark gray shale, *Lower Nineveh*	2435	2450
23	Shale, dark gray	2450	2473
31	Shale, dark gray, with some interbedded very fine-grained, light gray sandstone	2473	2504
18	Shale, dark purplish-red, silty, with some interbedded dark gray shale and some very fine-grained light gray to light greenish-gray sandstone	2504	2522
	Top of Gordon sand	2522	
7	Sandstone, very fine-grained, light gray, very slightly calcareous, with some interbedded gray shale	2522	2529
4	Sandstone, very fine-grained, light gray, containing a few subrounded quartz grains to 2 millimeters in diameter, with some interbedded gray shale	2529	2533
5	Sandstone, very fine-grained, light gray, with considerable interbedded gray to dark gray shale	2533	2538
8	Shale, dark gray, with considerable interbedded very fine-grained, light gray sandstone	2538	2546
9	Sandstone, very fine-grained, light gray, containing an occasional quartz grain to 2 millimeters in diameter, with some interbedded greenish-gray siltstone	2546	2555
7	Shale, dark gray, with considerable interbedded very fine-grained, light gray sandstone	2555	2562
	Bottom of Gordon sand		2562
3	Shale, greenish gray to dark gray, in part silty, with some interbedded very fine-grained, light greenish-gray sandstone	2562	2565
9	Shale, dark purplish-red, with considerable interbedded dark gray shale	2565	2574
6	Shale, dark gray, with considerable interbedded greenish-gray silty shale	2574	2580
6	Sandstone, very fine-grained, light gray, containing a few subrounded quartz grains to 3 millimeters in diameter—*Fourth sand*	2580	2586
23	Shale, dark gray	2586	2609
	Top of Fifth sand	2609	
8	Sandstone, very fine-grained, light greenish-gray, containing a few rounded milky quartz grains to 4 millimeters in diameter and a few minute particles of red shale, witb a great deal of interbedded gray to dark gray shale	2609	2617
6	Sandstone, coarse-grained, ligbt gray, slightly calcareous, with considerable interbedded gray to dark gray shale	2617	2623

Thickness		Depth in feet Top	Bottom
7	Sandstone, coarse-grained, light gray, almost white, very slightly calcareous—50 M.C.F. gas at 2629 feet	2623	2630
15	Sandstone, very coarse-grained, conglomeritic, light gray, almost white	2630	2645
	Bottom of Fifth sand		2645
	Conneaut group, 306+ feet.		
10	Shale, gray, in part silty	2645	2655
39	Shale, dark gray	2655	2694
24	Shale, dark gray, with considerable interbedded greenish-gray, silty shale	2694	2718
32	Shale, dark gray	2718	2750
2	Sandstone, very fine-grained, light grayish-brown, containing an occasional rounded quartz grain to 2 millimeters in diameter—*Bayard sand*	2750	2752
10	Siltstone, grayish-brown, containing a little muscovite, with a great deal of interbedded dark gray shale	2752	2762
28	Shale, dark gray	2762	2790
5	Shale, greenish-gray, silty, containing some muscovite	2790	2795
8	Siltstone, light greenish-gray, with a great deal of interbedded dark gray shale	2795	2803
5	Shale, greenish-gray, silty, with some interbedded dark purplish-gray shale	2803	2808
26	Siltstone, greenish-gray, containing some muscovite, with some interbedded purplish-gray silty shale and some dark gray shale	2808	2834
16	Shale, dark purplish-gray, silty, with considerable interbedded greenish-gray silty shale and some dark gray shale	2834	2850
13	Siltstone, dark purplish-gray, containing some muscovite, with a little interbedded greenish-gray siltstone and dark gray shale—39 M.C.F. gas at 2795-2863 feet	2850	2863
9	Shale, dark gray, with some interbedded greenish-gray siltstone	2863	2872
28	Shale, dark gray, with considerable interbedded greenish-gray siltstone containing occasional fragments of shells and some dark purplish-gray shale	2872	2900
20	Siltstone, greenish-gray, containing some muscovite and fragments of shells, with considerable interbedded dark gray shale	2900	2920
16	Siltstone, dark greenish-gray, containing occasional fragments of shells, with considerable interbedded dark purplish-gray, silty shale	2920	2936
15	Shale, dark purplish-gray, silty, with some interbedded dark gray silty shale	2936	2951
	Total depth		2951

Surface Stratigraphy

The consolidated strata exposed within the limits of the area consist in descending order of the Washington formation of the Permian system and the Monongahela group of the Pennsylvanian system. The Pittsburgh coal at the base of the Monongahela group crops out a short distance above stream level along Chartiers Creek in the northwest corner. The Monongahela group, with the Waynesburg coal at the top and the Pittsburgh coal at the bottom, has an average thickness of 284 feet. In the drillers' logs the interval recorded between the top of the Waynesburg coal and the bottom of the Pittsburg coal varies from 255 to 322 feet.

Subsurface Stratigraphy

Approximately 3400 feet of strata below the Pittsburgh coal have been penetrated by the drill in the North Strabane area. One of the wells, the Wallace Hamilton No. 1, Amity 213, for which a complete section is given, penetrated the horizon of the Elizabeth sand. In all, 18 wells have been drilled through the Elizabeth horizon of the Conneaut group of the Upper Devonian series and one through the Speechley of the underlying Canadaway group.

PENNSYLVANIAN SYSTEM

Conemaugh group. The Conemaugh group includes the strata between the bottom of the thin clay underlying the Pittsburgh coal and the top of the Upper Freeport coal. In the North Strabane area the thickness of this group ranges from 594 to 662 feet, the average being 635 feet.

The Conemaugh group consists of an alternating succession of clay, shale, sandy shale, and sandstone beds with some thin limestones and an occasional coal seam. Clays and shales predominate. Some of the clays and shales are red, particularly in the upper one-half of the group. The Ames limestone, a marine, fossiliferous limestone, about two feet thick, intercalated between red and gray clays and shales near the middle, constitutes a good key horizon but is rarely recorded by the drillers. It can frequently be recognized in the drill cuttings. The Morgantown sandstone in the upper half of the group is sometimes recorded by the drillers and is called the Murphy sand. In the lower half of the group, sands occurring at Saltsburg, Buffalo, and Mahoning horizons are sometimes recorded. Drillers call the Buffalo the Little Dunkard and the Mahoning the Big Dunkard. Only shows of gas have been encountered in these sands in the North Strabane area.

Allegheny Group, Restricted. Dr. Ashley recently has proposed that the Allegheny group be restricted to the strata between the top of the Upper Freeport coal and the base of the Lower Kittanning coal and that the section between the base of the Lower Kittanning and the top of the Homewood sandstone be included in the Pottsville series.[1] Thus restricted, the Allegheny group has an average thickness of 175 feet in the area.

The Allegheny group consists of shale, sandstone, several coal beds and an occasional thin limestone. It was found that the Lower Freeport coal is recorded more frequently by the drillers in the North Strabane area than the Upper Freeport coal. The interval between it and the base of the Pittsburgh coal ranges from 647 to 702 feet, the average being 675 feet.

Upper Pottsville-Kanawha Series. The strata below the base of the Lower Kittanning coal and the unconformity at the base of the Pennsylvanian system are here considered to belong to the Upper Pottsville-Kanawha series. This interval contains several prominent sandstones separated by varying thicknesses of shale and occasionally a coal bed. In descending order the sandstones on the outcrop are known as the Kittanning, Clarion, Homewood, and Connoquenessing. The Kittanning sandstone, when recorded by the drillers, is usually called the First Gas sand; the Homewood, the First Salt sand; and the Connoquenessing, the Second Salt sand. In parts of the North Strabane area, a shale break divides the Connoquenessing into an upper and a lower member. The lower member is called the Maxton, where recognized, although the sand probably occurs at a somewhat higher horizon than the Maxton of Ohio. The First Salt sand has been an important source of gas in the North Strabane area.

[1] Ashley, George H., The Pittsburgh-Pottsville Boundary: Journal of Geology, vol. LIII, p. 389, 1945.

MISSISSIPPIAN SYSTEM

Strata possessing the lithological characteristics of the Mauch Chunk group were not recognized in the three wells from which complete sets of drill-cutting samples were available. Apparently the regional unconformity that marks the break between the Pennsylvanian and Mississippian systems throughout western Pennsylvania eliminated this entire group in the North Strabane area.

Greenbrier Group. The Upper Pottsville-Kanawha series rests unconformably on limestones belonging to the Greenbrier group. In the Harry Hatfield No. 1 well, the upper member of this group consists of 48 feet of very fine, dense, light brownish gray to grayish brown, fossiliferous, marine limestone, slightly argillaceous in the upper part; and in the Mary W. Neill No. 1 well, of 26 feet of similar fossiliferous limestone. This is the limestone that Campbell considered to be the feather edge of the prominent Greenbrier limestone of West Virginia and he referred to it as the Greenbrier lentil in the Mauch Chunk shale in outcrops along Chestnut Ridge.[2] It is the limestone that the drillers call the Big Lime throughout the North Strabane area. Where a shale break separates it into two parts, the upper part may be recorded as the Little Lime and the lower part as the Big Lime.

The Greenbrier limestone usually rests directly on a fine-grained, dense, light brownish to greenish-gray, very sandy limestone, 45 to 65 feet thick. Occasionally a thin shale break separates the two. The sandy limestone possesses the lithological characteristics and occupies the stratigraphic position of the Loyalhanna limestone at its type locality in the Loyalhanna Gorge in Westmoreland County with which it is correlated. In the Wallace Hamilton No. 1 well, the upper purer limestone above is cut out by the unconformity and the Pottsville lies directly on the sandy Loyalhanna.

When Butts first named the Loyalhanna, he included it in the Pocono.[3] Later he separated it from the Pocono and correlated it with the Ste. Genevieve limestone of the Mississippi Valley.[4] Butts recognized the existence of a hiatus of considerable magnitude between the Loyalhanna and the underlying Burgoon sandstone of the Pocono group. Reger [5] and Lucke [6] have shown that the Loyalhanna limestone of southwestern Pennsylvania has the stratigraphic position of the lower part of the Union member, the third from the top of the eleven members into which the Greenbrier limestone of West Virginia has been sub-divided and that the overlying purer limestone probably represents the northward extension into Pennsylvania of the upper part of the Union member. In southern West Virginia the Greenbrier has a total thickness of 1200 feet.

[2] Campbell, Marius R., U. S. Geol. Survey, Geol. Atlas, Masontown-Uniontown folio (no. 82), p. 6, 1902; Brownsville-Connellsville folio (no. 94), p. 8, 1903; Latrobe folio (no. 110), p. 6, 1904.

[3] Butts, Charles, U. S. Geol. Survey, Geol. Atlas, Kittanning folio (no. 115), p. 15, 1904.

[4] Butts, Charles, The Loyalhanna limestone of southwestern Pennsylvania, especially with regard to its age and correlation; Amer. Jour. Sci., 5th series, vol. 8, pp. 249-257, 1924.

[5] Reger, David B., Randolph County: West Virginia Geological Survey (County Reports), pp. 328-330, 1931.

[6] Lucke, John B., Limestones from Mississippian to Permian: West Virginia Geological Survey, vol. XII, p. 50, 1939.

Starting at the Allegheny Front west of Altoona, the Loyalhanna limestone can be traced west across southwestern Pennsylvania to the State line by outcrops and well samples. Throughout the entire distance it maintains a relatively uniform thickness and it is thought that its top is very nearly a surface of time equivalence. Its top can be picked in well logs as the drillers of the North Strabane area consistently log it as the top of the Big Injun sand.

Pocono Group. The Pocono group has a thickness of about 530 feet in the North Strabane area. It consists of shale, siltstone, sandy shale, and sandstone. The top member, called the Big Injun by the drillers, who include with it the Loyalhanna, has an average thickness of about 180 feet, excluding the Loyalhanna. This part correlates with the Burgoon sandstone on the outcrop. Some gas has been obtained from the Big Injun sand in the North Strabane area.

Near the middle of the Pocono group there is a sandy zone in the area, designated as the Squaw sand by the drillers. Several thin beds of very fine-grained, light gray sandstone interstratified with shale occur in this zone. Shows of gas have been encountered, but there has been no commercial production from the zone.

Another very fine-grained, light gray sandstone containing much interstratified shale occurs at the bottom of the Pocono group. It can be correlated with the Murrysville sand of the gas fields to the east.[7] A similar but thinner sand occurring about 60 feet above corresponds in position to the Second Gas sand. True Berea is absent. No production has been reported from the Second Gas or Murrysville sands in the North Strabane area, although occasionally a show of gas is encountered in the Murrysville.

UPPER DEVONIAN SERIES

Conewango Group. The strata between the base of the Murrysville and the base of the Fifth sand have been assigned to the Conewango group. This interval has an average thickness of about 510 feet. As in the Venango district,[8] the Conewango group in the North Strabane area includes three rather distinct sand zones separated by gray shales. The feather edges of a few thin tongues of brick- to purplish-red silty shale from the Catskill facies to the east extend into its middle and lower parts.

The top of the First Sand zone occurs about 115 feet below the top of the group and has an average thickness of approximately 100 feet. It comprises the Gantz and Fifty-foot sands of the drillers. In the North Strabane area a shale break usually separates the two. Where this is absent, the entire sand body is referred to as the Hundred-foot. The Gantz sand has been the most important oil-producing sand in the North Strabane area and has also yielded considerable gas. The Fifty-foot sand has been of less importance.

The Second Sand zone contains the Upper and Lower Nineveh sands. It occurs about 275 feet below the top of the Conewango group

[7] Demarest, David F., Map of the Berea and Murrysville Sands of Northeastern Ohio, Western Pennsylvania, and Northernmost West Virginia: U. S. Geol. Survey Oil and Gas Investigations, Preliminary Map 49, 1946.

[8] Sherrill, R. E., Oil and Gas Geology of the Oil City Quadrangle, Pennsylvania: Pennsylvania Geol. Survey, 4 ser., Bull. M 25, pp. 23-40, 1943.

and has an average thickness of 40 feet. The Nineveh sands in the North Strabane area are very fine-grained and contain much interbedded shale. The break that separates the Upper from the Lower usually carries a seam of red shale. The Nineveh sands have not been productive in the area. Occasionally a show of gas is reported in them.

The Third Sand zone occurs about 350 feet below the top of the Conewango group and has an average thickness of 150 feet. In descending order this zone contains the Gordon Stray, the Gordon, the Fourth, and the Fifth sands. These sands are separated from one another by only short intervals and adjacent members merge locally, making exact correlations over any considerable distance impossible. The Gordon Stray and the Fourth, as recognized in the area, have not been productive. The Gordon and the Fifth sands consist of very fine-grained to coarse, conglomeritic, light gray, quartz sandstones with varying amounts of clay minerals. Two small oil pools have been developed in the North Strabane area in the Gordon sand and the Fifth sand has been an important source of gas.

Conneaut Group. The Conneaut group consists mostly of gray shales and siltstones, many of them fossiliferous. About 10 feet below the top the strata in part become purplish-gray for an interval of about 250 feet. The Bayard and Elizabeth sands of southwestern Pennsylvania occur in the Conneaut group.

In the North Strabane area 26 wells have penetrated the horizon of

TABLE 1. Intervals in feet between important horizons and the bottom of the Pittsburgh coal in the North Strabane area.

	Average	*Minimum*	*Maximum*
Top of Waynesburg coal	284	255	322
Bottom of Pittsburgh coal	0	0	0
Top of			
Murphy sand	166	123	200
Saltsburg sandstone	375	315	433
Little Dunkard sand	475	405	535
Big Dunkard sand	586	532	634
Upper Freeport coal	635	594	662
Lower Freeport coal	673	647	702
First Gas sand	796	743	854
First Salt sand	900	836	979
Second Salt sand	984	926	1052
Maxton sand	1079	1046	1118
Big Lime	1105	1044	1146
Big Injun sand (top of Loyalhanna)	1145	1106	1203
Squaw sand	1445	1363	1534
Murrysville sand	1686	1595	1739
Gantz sand	1842	1796	1880
Fifty-foot sand	1901	1845	1951
Upper Nineveh sand	1995	1956	2028
Lower Nineveh sand	2028	1995	2068
Gordon Stray sand	2071	2026	2103
Gordon sand	2096	2035	2132
Fourth sand	2168	2133	2215
Fifth sand	2211	2181	2241

the Bayard sand, which lies about 100 feet below the bottom of the Fifth sand or top of the Conneaut group. Two wells obtained small flows of gas from this sand. In most places it is represented by siltstone, but where sandstone occurs, it rarely exceeds a few feet in thickness and is very fine grained.

The horizon of the Elizabeth sand occurs in the upper part of the purplish-gray zone. Eighteen wells have tested this horizon in the North Strabane area, one of which encountered a small flow of gas. Only siltstone, as a rule, is found at the horizon of the Elizabeth sand in the area.

Canadaway Group. The Canadaway group, like the Conneaut, consists predominantly of shale and siltstone. The horizon of the Speechley sand occurs in its upper part. One well in the North Strabane area has penetrated this horizon. No production was encountered in it.

Intervals between Important Horizons. The intervals in feet between important horizons and the bottom of the Pittsburgh coal and the top of the Big Injun sand of the drillers are given in Tables 1 and 2, respectively. These have been computed from the well records included in Table 3 of the appendix. Southwest-northeast and northwest-southeast correlation sections, showing the positions of the sands below the top of the Loyalhanna limestone, which corresponds to the top of the Big Injun sand of the drillers, are presented in plate 2.

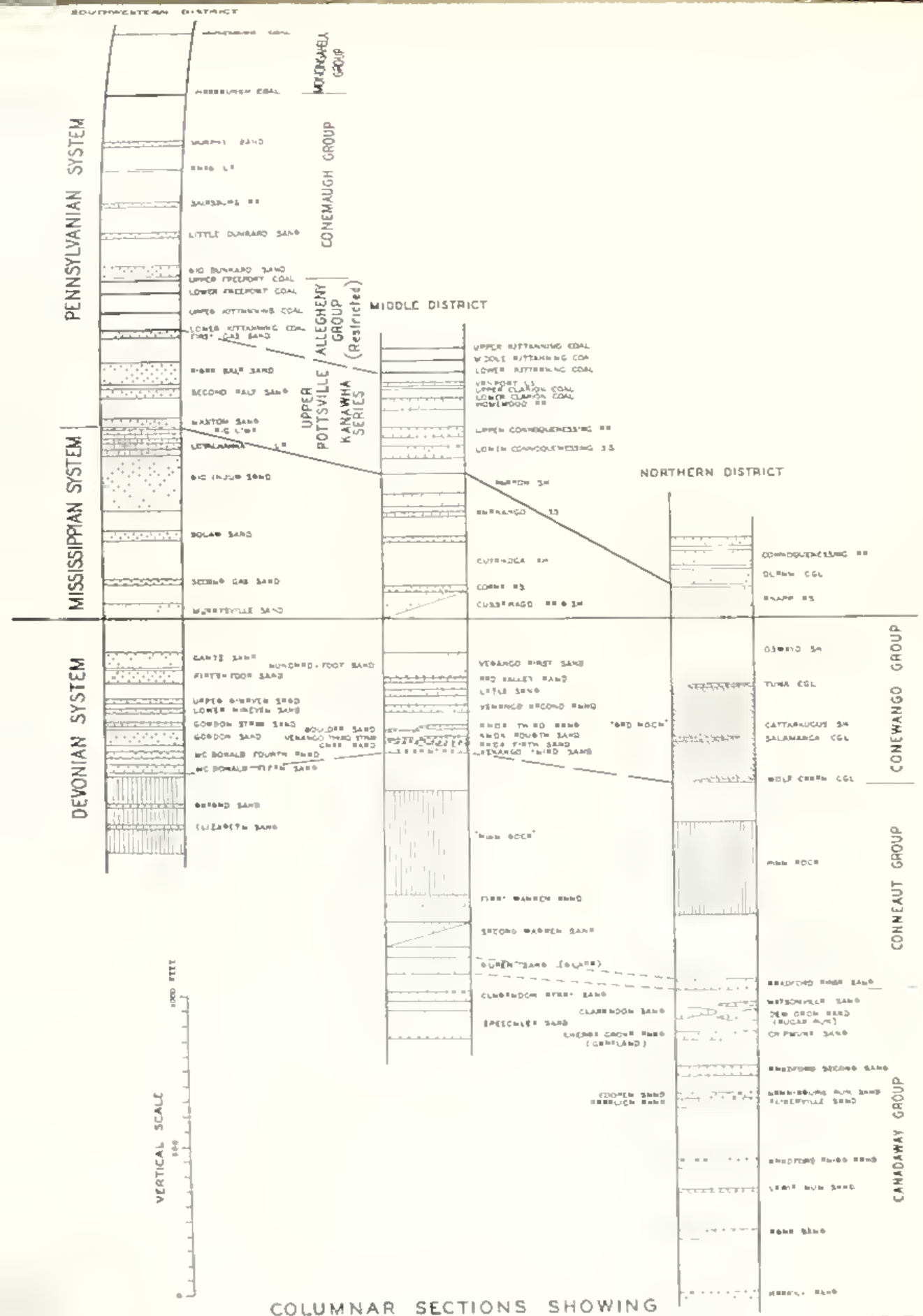
TABLE 2. Intervals in feet between important sands and the top of the Big Injun sand.

	Average	*Minimum*	*Maximum*
Top of			
Big Injun	0	0	0
Squaw	308	217	389
Murrysville	540	453	595
Gantz	702	633	745
Fifty-foot	761	707	810
Upper Nineveh	859	817	890
Lower Nineveh	888	863	920
Gordon Stray	929	860	959
Gordon	957	906	991
Fourth	1029	988	1083
Fifth	1073	1054	1118

STRUCTURE

The western half of the North Strabane area lies on the east flank of the Washington anticline, a major structural feature of southwestern Pennsylvania. The Nineveh syncline trends nearly northsouth, a little west of Linden. Local structural anomalies of low relief and indefinite shape are common, especially in the synclinal trough.

It does not appear that structure had more than minor control of oil and gas accumulation. However, in order to approach a detailed study of the oil and gas sands, it is necessary to have a thorough knowledge of the deformation that the sands have undergone.



COLUMNAR SECTIONS SHOWING

STRATIGRAPHIC POSITIONS OF OIL AND GAS SANDS

OF WESTERN PENNSYLVANIA

Plate 2

Structure of base of Pittsburgh coal

The structure map drawn on the base of the Pittsburgh coal (fig. 2) shows numerous local structural anomalies. Comparison of the structure maps of the base of the Pittsburgh coal and the top of the Loyalhanna limestone (fig. 3) shows that many of the local structural features of the Pittsburgh coal are absent from the section below. The Loyalhanna lies at the top of an interval of competent beds containing abundant sandstone, while the Pittsburgh coal is embraced

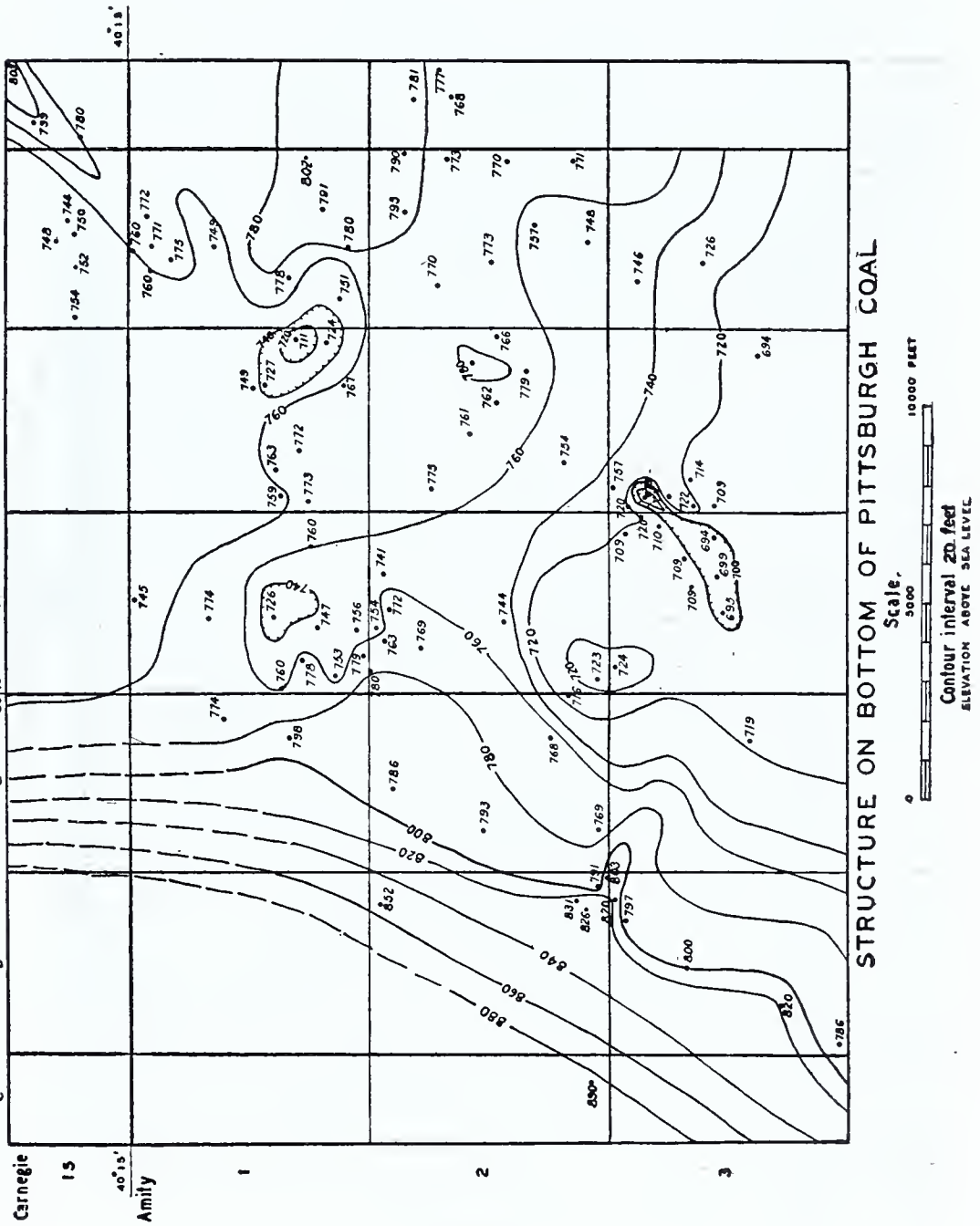


Figure 2

in an interval of more abundant clays and shales and the section is less competent. It is probable, therefore, that the Pittsburgh coal was folded more intensely than the more competent section of Loyalhanna limestone and underlying sandstones, causing local structural anomalies not reflected in this more competent section. Lack of conformity of the two structure patterns may also be due to several other causes. Coal has been shown in some places to have accumulated on an undulating topography of low relief as well as on a plane surface,

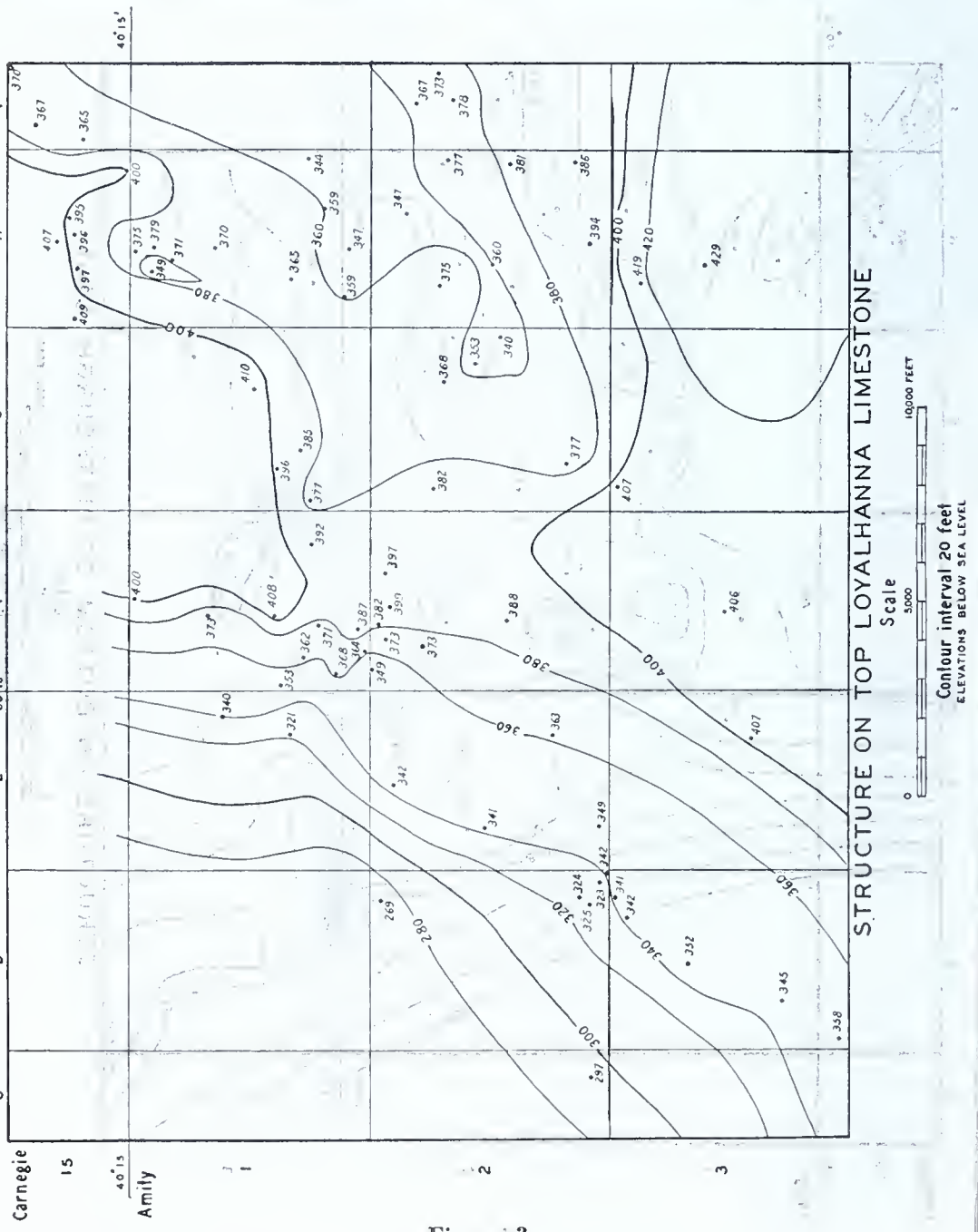


Figure 3

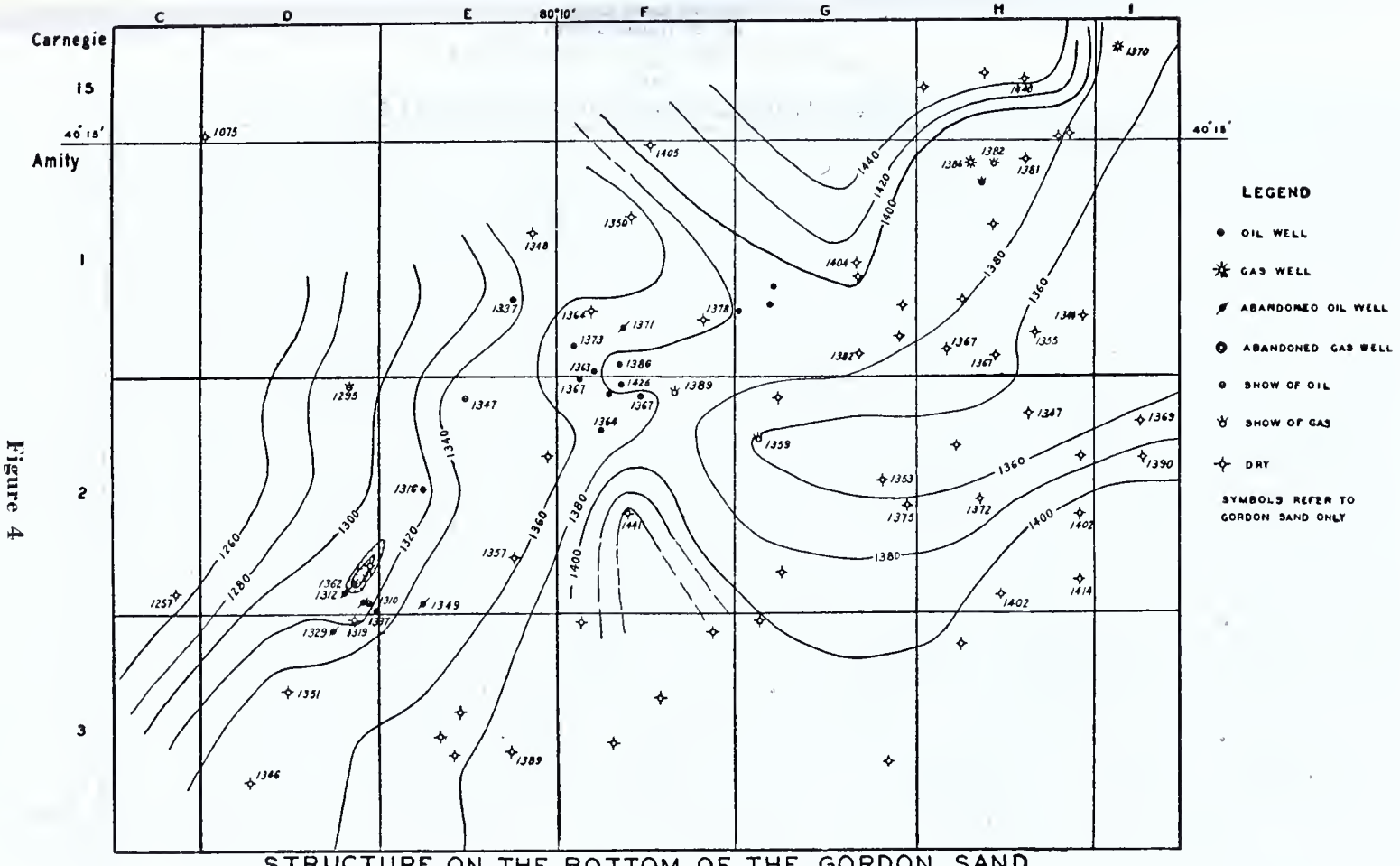

C
D
E
80°10'
F
G
H
I
Carnegie
15
40°15'
Amity
1
2
3
40°15'
LEGEND
OIL WELL
GAS WELL
ABANDONED OIL WELL
ABANDONED GAS WELL
SHOW OF OIL
SHOW OF GAS
DRY
SYMBOLS REFER TO GORDON SAND ONLY
STRUCTURE ON THE BOTTOM OF THE GORDON SAND
Scale
0
5000
10000 FEET
Contour interval 20 feet
ELEVATIONS BELOW SEA LEVEL

Figure 4

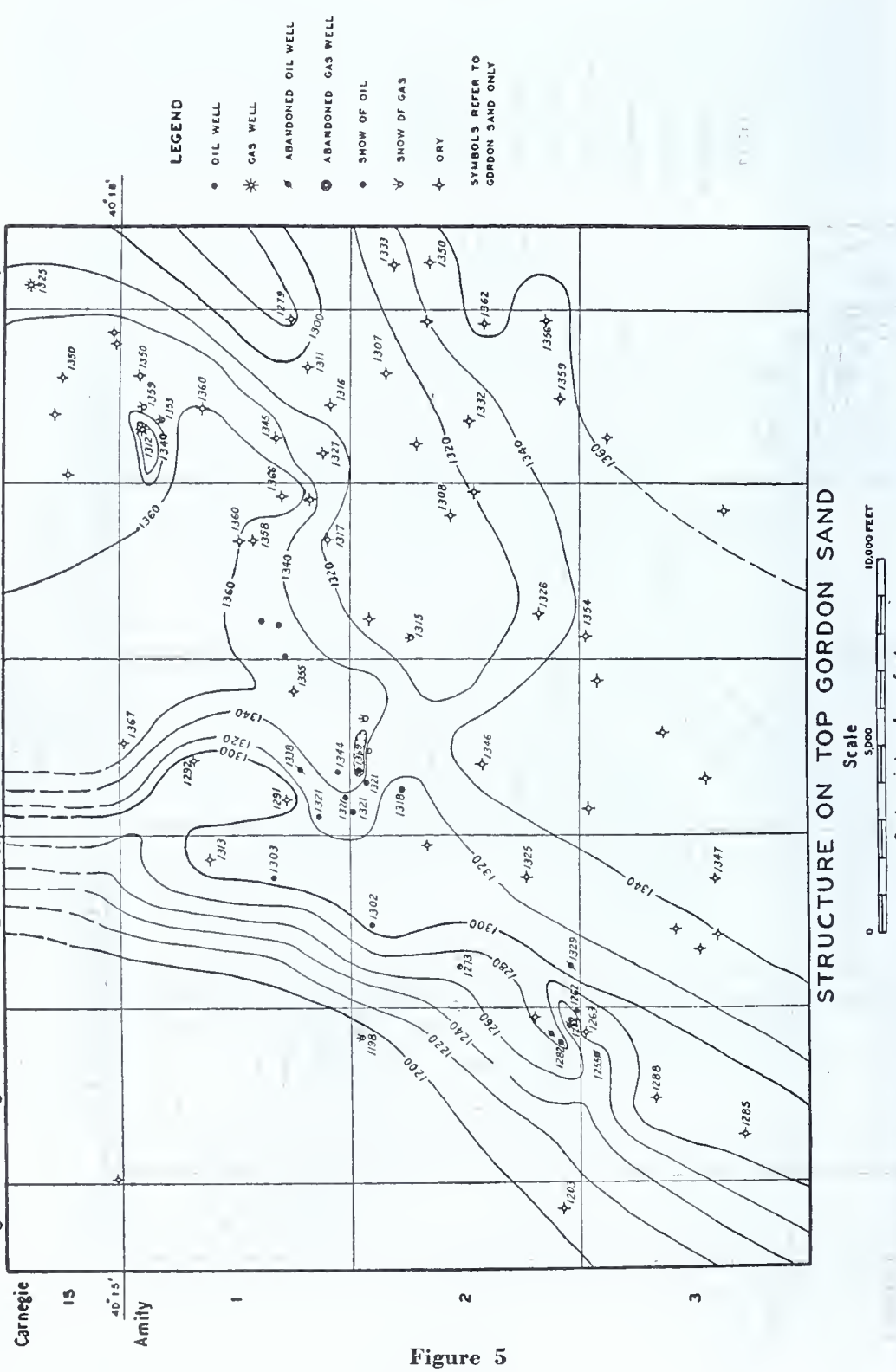

LEGEND
OIL WELL
GAS WELL
ABANDONED OIL WELL
ABANDONED GAS WELL
SHOW OF OIL
SHOW OF GAS
DRY
SYMBOLS REFER TO GORDON SAND ONLY
STRUCTURE ON TOP GORDON SAND
Scale
5,000
10,000 FEET
Contour interval 20 feet
ELEVATIONS BELOW SEA LEVEL
Carnegie
Amily
40°18'
40°15'
80°10'
C
D
E
F
G
H
I
1
2
3
15

Figure 5

though the Pittsburgh coal with its persistent underclay and limestone more likely was deposited in an environment of little or no relief. Convergenee of the beds eonstituting the interval between the Pittsburgh coal and the top of the Loyalhanna may be due to deformation during their deposition. Differential eompaction may also be a factor. Because of these factors that eomplieate the struetural relationships of the Pittsburgh coal with the oil-bearing sand seetion below, it is not feasible to use the Pittsburgh eoal as a datum of referenee in sand studies.

Structure of top of Loyalhanna limestone

The structure map drawn on the top of the Loyalhanna limestone (fig. 3), logged by the drillers as the top of the Big Injun, portrays more nearly the structure of the oil- and gas-bearing sands lying below than does the structure map of the bottom of the Pittsburgh coal. Some convergence may exist between the top of the Loyalhanna limestone and the sands, but eross seetions through the area (pl. 2) show consistent intervals. It was found after much consideration that the top of the Loyalhanna limestone affords the only satisfactory datum for the interpretation of the strueture of the underlying sands in the North Strabane area.

Structure of bottom and top of Gordon sand

The structure maps drawn on the bottom and the top of the Gordon sand (figs. 4 and 5 respectively) show present elevations of the sand surfaces with respeet to sea-level. They represent a combination of the struetural deformation and the shape of the sand body at the time of deposition, rather than true deformation.

OIL AND GAS RESOURCES

Oil has been produced in the North Strabane area since 1886. Unfortunately no figures as to the quantity are available. Produetion today is small and nearly two-thirds of the old wells have been abandoned. All of the oil has eome from sands of the Upper Devonian series. Gas, on the other hand, is being obtained from strata of Pennsylvanian and Mississippian age as well as Upper Devonian.

The intensity of development of the oil and gas resourees of the area is shown on the oil and gas map, plate 1. A total of 242 wells are ineluded on this map. Undoubtedly there are some others whose loeations today are unknown. Of those shown, 32 are producing oil wells, 53 are abandoned oil wells, 41 are produeing gas wells, 75 are abandoned gas wells, and 41 were eompleted as dry holes. In the 13,600 aeres included in the North Strabane area, this gives an average density of one well to eaeh 56 acres. This figure is somewhat misleading, however, beeause the spaeing in the developed pools, particularly the oil pools, is considerably eloser than in the outside areas. Reeords were obtained for approximately one-half of the wells known. These have been eompiled in Table 3 of the appendix.

In drilling for oil and gas in the North Strabane area, three strings of easing are usually employed. A 10-ineh string is set about 30 feet below the bottom of the Pittsburgh coal. An 8¼-inch string is set at

a point somewhere between the bottom of the Little Dunkard sand and the upper part of the First Salt sand, its location depending on what sands in the Conemaugh and Allegheny groups are water-bearing in the locality. A 6⅝-inch string is set either in the Big Lime or a point somewhere in the upper part of the Big Injun sand to shut off the water encountered in the Salt sands. Occasionally enough water is encountered in the Gantz and Fifty-foot sands to necessitate setting the 6⅝-inch casing below the bottom of the Fifty-foot sand. Where little or no water is encountered in the sands of the Conemaugh and Allegheny groups, the intermediate string is sometimes omitted and an 8¼-inch string substituted for the 10-inch through the Pittsburgh coal.

Description of Oil and Gas Sands

Oil in commercial quantities has been obtained from three sands in the North Strabane area. In descending order, these are the Gantz, the Fifty-foot, and the Gordon. Five sands have produced gas; namely, the First Salt, the Big Injun, the Gantz, the Fifty-foot, and the Fifth.

No shows of gas or oil have been reported from the Murphy sand. The Saltsburg, the Little Dunkard, and the Big Dunkard in places have yielded initial open flows of as high as 100,000 cubic feet of gas per day, but the gas soon exhausted itself. Water is sometimes encountered in these sands. Shows of gas are occasionally reported in the First Gas sand, but no commercial production has been developed. Water is present in this sand in places.

FIRST SALT SAND

The First Salt sand has yielded appreciable volumes of gas in the North Strabane area. The sand consists of a fine- to coarse-grained, light gray, nearly white, quartzose sandstone. Shale breaks, ranging from one to 15 feet in thickness, are common. The average thickness is about 70 feet, but thickness as low as 14 feet and as high as 195 feet have been recorded. Where the greater thicknesses are reported, it is likely that the shale break separating the First and Second Salt sands is thin and the latter is included with the First.

The gas pay in the First Salt sand usually occurs below the middle of the sand and ranges from two to 20 feet in thickness. Initial open flow capacities of wells range from 75,000 to 600,000 cubic feet of gas per day, but the wells are not long-lived. In many places, considerable quantities of salt water are present in this sand.

The Second Salt sand and the Maxton are only of very minor importance as sources of gas in the North Strabane area. Salt water is commonly encountered in them.

BIG INJUN SAND

As has been previously pointed out, the drillers of the North Strabane area include the Loyalhanna limestone in the Big Injun sand. The Loyalhanna limestone is a tight, sandy limestone and is nonproductive.

The Big Injun sand proper has yielded some gas in the area. The sand consists of a very fine- to medium-grained, light gray sandstone.

Shale breaks, ranging from one to 30 feet in thickness, occur in it. The average thickness of sand is about 180 feet.

Gas pays in the Big Injun sand, when present, range from four to 20 feet in thickness and are confined mostly to the upper half. Usually only one is encountered, but occasionally two are reported. Wells in the Big Injun sand have open flow capacities of from 40,000 to as high as 4,000,000 cubic feet of gas per day, but are short-lived. Occasionally some salt water is encountered in the Big Injun sand.

The Squaw and the Murrysville sands have not contributed to the gas and oil production of the area, but occasionally shows of gas are reported in them.

GANTZ SAND

The Gantz sand had been the source of much of the oil produced in the North Strabane area. Considerable gas has been obtained from it also. The sand consists of a succession of light-gray quartzose sandstone layers, ranging in texture from very fine to coarse and conglomeritic, and an occasional interbedded shale bed. The lower part usually is coarser than the upper, but in places conglomeritic lenses occur near the top also. The shale beds or breaks range in thickness from two to 15 feet. The sand body ranges in thickness from 24 to 109 feet, the average being about 50 feet. Where the greater thicknesses are recorded, it is likely that part of the Fifty-foot sand is included.

The pay zones in the Gantz sand are from two to 16 feet thick. Where only one is present, this may occur either in the upper or the lower part. Where two are found, one usually occurs in the upper and the other in the lower part. Some of the early oil wells in the Gantz sand had initial productions of as much as 85 barrels per day. Some recent wells have started at 15 barrels. Gas wells in the Gantz sand have initial open flow capacities of from 50,000 to 500,000 cubic feet of gas per day. Salt water is occasionally encountered in this sand.

FIFTY-FOOT SAND

The Fifty-foot sand has produced oil and gas at a few localities in the North Strabane area. The sand resembles the Gantz, except that in general it is somewhat finer in texture and shale breaks are of more common occurrence in it. The upper part usually is coarser than the lower. The sand ranges in thickness between 10 and 86 feet, the average thickness being about 45 feet. The greater thicknesses probably include part of the Gantz. Pay zones in this sand are from two to ten feet thick and may occur in either the upper or lower part. Usually only one is present. Oil wells in this sand have initial productions from 15 to 35 barrels per day and gas wells, initial open flow capacities from 100,000 to 575,000 cubic feet of gas per day. Salt water is present in some places.

Only occasional shows of gas have been reported from the Upper and the Lower Nineveh sands in the North Strabane area. These sands possess a very fine texture in the area and are relatively thin. Considerable shale is interbedded with them.

SECTION AND PERMEABILITY AND POROSITY PROFILES OF GORDON SAND CORE FROM J.L. KENAMOND NO.1 WELL, NORTH STRABANE TWP, WASHINGTON CO., PA.

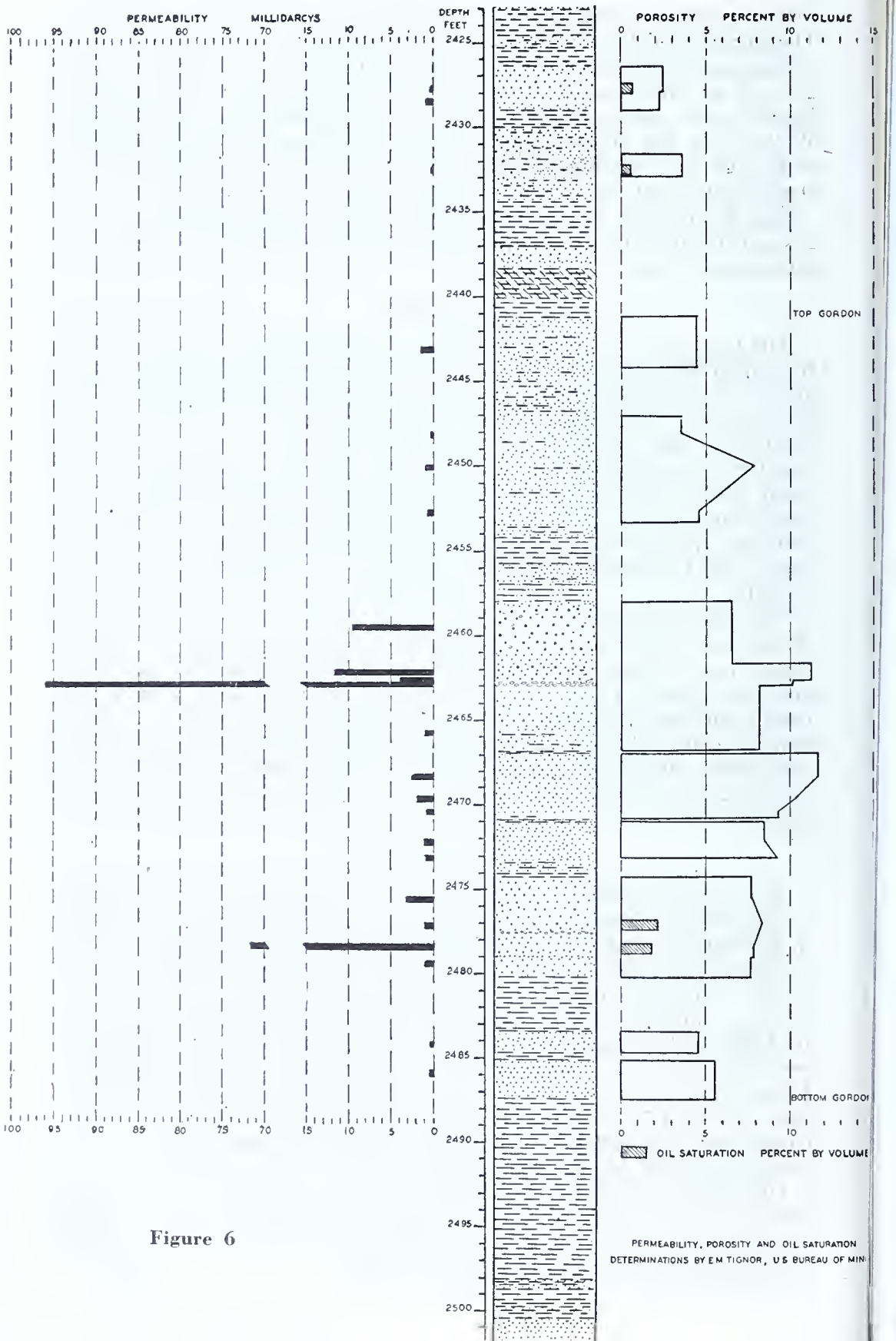


Figure 6

GORDON SAND

Only one small oil pool had been developed in the Gordon sand in the North Strabane area prior to the discovery of the Gordon sand pool southeast of the Chartiers Hill Church. In the southwestern portion of the area 6 wells on the Lutton and Gushard farms have produced oil from the Gordon sand, though this production was erroneously associated with the Fourth sand. Some gas has been obtained from this sand in two wells in the northeast part of the area. The Gordon sand is composed of a succession of layers of light gray quartzose sandstone, ranging in texture from very fine to coarse. Thin conglomeritic seams and lenses occur in some of the coarser sandstone layers. Shale seams ranging in thickness from a few inches to several feet are frequently interbedded with the sandstone. The thickness of the Gordon sand ranges from 22 to 95 feet, the average being about 50 feet. The greater thicknesses are encountered where either the Gordon Stray or the Fourth sand merge with it.

When present, pay zones in the Gordon range from 3 feet to 18 feet in thickness and occur anywhere from 14 to 44 feet below the top of the sand. Usually only one pay zone is encountered, but occasionally there are two. In the latter case, the individual zones are 5 to 7 feet. Some of the larger wells in the recent Gordon sand development have had initial productions of 100 to 135 barrels of oil per day. Most of them settle rapidly to a daily production of 4 to 20 barrels on the pump, although one was still producing at the rate of 50 barrels per day one year after completion. One well started to flow at the rate of 50 barrels per hour when the sand was drilled in, but within a few weeks was down to 20 barrels per day.

A complete section of the Gordon sand was obtained from a diamond core taken by the Pennsylvania Geological Survey during the fall of 1945 in the J. L. Kenamond No. 1 well 2F6 of Charles E. Young. This section is given below and is shown graphically in figure 6 together with permeability and porosity profiles. The permeability, porosity, and oil saturation determinations were made by E. M. Tignor of the Petroleum Field Office of the United States Bureau of Mines at Franklin, Pa., and are described by him in a later part of this report. The well is on the southeastern edge of the recently discovered Gordon Sand oil pool. It produces between 1 and 1½ barrels of oil per day. It will be noted that, with the exception of two thin streaks, permeabilities are low and that porosities in excess of 10 percent by volume occur in only 4.3 feet of the sand. The highest porosity found was 11.7 percent.

Section of Gordon Sand from J. L. Kenamond No. 1 Well of Charles E. Young and Associates

North Strabane Township, Washington County, Pa.

Thickness feet	*Description of strata, by R. C. Stephenson*	*Depth in feet* *Top*	*Bottom*
.17	Sandstone, very fine-grained, gray, hard, somewhat micaceous (muscovite) and slightly shaly	2423.00	2423.17
1.50	Shale, dark gray, containing a little finely disseminated pyrite with some irregularly interbedded thin seams of very fine-grained, gray, abundantly micaceous sandstone	2423.17	2424.67

Thickness		Depth in feet Top	Bottom
.67	Sandstone and shale, similar to above, interbedded	2424.67	2425.34
1.08	Shale, greenish-gray, containing some disseminated pyrite and becoming increasingly sandy toward base	2425.34	2426.42
1.50	Sandstone, fine-grained, light greenish-gray, slightly calcareous—show of oil	2426.42	2427.92
1.17	Sandstone, very fine-grained, light grayish-green, very slightly calcareous, containing a few greenish- and purplish-gray shale fragments	2427.92	2429.09
1.00	Shale, dark greenish-gray, slightly micaceous, containing several sandstone seams similar to above	2429.09	2430.09
1.50	Sandstone, fine-grained, light gray to gray, slightly calcareous, containing numerous very thin dark gray shale seams	2430.09	2431.59
1.33	Siltstone, greenish-gray, shaly, containing some disseminated pyrite grains and a few rounded quartz grains and white pebbles	2431.59	2432.92
1.58	Sandstone, very fine-grained, light grayish-green, containing a considerable number of brick-red shale fragments and wavy shale seams	2432.92	2434.50
2.58	Shale, dark gray, thin bedded and fissile, containing some plant remains which decrease in number downward as the shale becomes more sandy	2434.50	2437.08
.83	Sandstone, fine-grained, greenish-gray, silty, containing a few fragments of reddish-brown shale	2437.08	2437.91
.50	Sandstone, very fine-grained, greenish-gray	2437.91	2438.41
1.75	Shale, reddish to chocolate-brown, fine micaceous, containing a nearly vertical veinlet of sandstone	2438.41	2440.16
1.09	Shale, dark gray, fissile, slightly micaceous	2440.16	2441.25
	Top of Gordon sand	2441.25	
3.00	Sandstone, very fine to fine-grained, light greenish-gray, fairly hard, containing some greenish-gray shale fragments and wavy shale seams	2441.25	2444.25
.58	Sandstone, similar to above, with interbedded dark gray, finely micaceous shale seams	2444.25	2444.83
1.42	Sandstone, fine-grained, light gray, hard, somewhat calcareous, containing numerous thin seams of dark gray shale	2444.83	2446.25
.92	Sandstone, very fine-grained, dark gray, dense, hard, shaly	2446.25	2447.17
6.17	Sandstone, very fine-grained, light greenish-gray, tight and hard, containing a little muscovite and a few dark greenish-gray silty shale fragments and wavy shale seams —two shells of a pelcypod observed at 2450.00 feet ...	2447.17	2453.34
.91	Sandstone, similar to above, very irregularly interbedded with dark gray shale	2453.34	2454.25
1.50	Shale, dark gray	2454.25	2455.75
1.25	Sandstone, very fine to fine-grained, light greenish-gray, shaly in part	2455.75	2457.00
1.00	Shale, dark greenish-gray, sandy	2457.00	2458.00
.33	Sandstone, fine-grained, dark gray, silty, hard and tight, containing considerable number of round quartz pebbles —faint odor of petroleum on fresh fracture	2458.00	2458.33
2.75	Sandstone, coarse, conglomeritic, light greenish-gray, with rounded quartz pebbles to 10 millimeters in diameter and coarse subangular quartz grains imbedded in a clay matrix—faint odor of petroleum on fresh fracture	2458.33	2461.08
.67	Sandstone, fine-grained, light gray, almost white, hard and tight	2461.08	2461.75
.42	Sandstone, fine to medium-grained, light gray, somewhat conglomeritic with some subrounded quartz pebbles to 5 millimeters in diameter	2461.75	2462.17
.58	Sandstone, fine to medium-grained, light greenish-gray, almost white, containing a little clay—faint odor of petroleum on fresh fracture	2462.17	2462.75
.25	Conglomerate, light gray, with quartz pebbles, mostly discoidal to 10 millimeters in diameter imbedded in a fine sand and clay matrix—contains some large pores—faint odor of petroleum on fresh fracture	2462.75	2463.00
2.50	Sandstone, fine-grained, light greenish-gray	2463.00	2465.50
1.33	Sandstone, very fine to fine-grained, light greenish-gray, containing several thin dark gray, micaceous shale seams —show of gas and oil	2465.50	2466.83
.08	Shale, very dark gray, micaceous	2466.83	2466.91
3.67	Sandstone, very fine-grained, light greenish-gray, containing a little muscovite—show of gas and oil	2466.91	2470.58
.25	Sandstone, similar to above, with some interbedded thin dark gray shale seams	2470.58	2470.83
.17	Shale, dark gray, in part micaceous, with a few plant remains	2470.83	2471.00
2.17	Sandstone, very fine-grained, light greenish-gray, containing a little muscovite—faint odor of petroleum	2471.00	2473.17

Thickness		Depth in feet Top	Bottom
.92	Sandstone, very fine-grained, light gray, with numerous interbedded very thin, irregular dark gray shale seams	2473.17	2474.09
.16	Shale, dark gray, micaceous	2474.09	2474.25
4.75	Sandstone, fine-grained, very light gray, nearly white, with fine quartz pebble layers at 2477.58 and 2478.67 feet—good show of gas and oil	2474.25	2479.00
1.17	Sandstone, very fine to fine-grained, very light gray, containing a flattened and carbonized plant stem 5 millimeters thick and 20 millimeters wide at 2479.5 feet and a fine quartz pebble layer at top—good show of gas and oil	2479.00	2480.17
3.16	Shale, dark gray, micaceous	2480.17	2483.33
1.34	Sandstone, very fine-grained, very light gray, containing a little muscovite	2483.33	2484.67
.41	Shale, dark gray	2484.67	2485.08
2.25	Sandstone, very fine-grained, light greenish-gray, containing a little muscovite and some greenish-gray shale fragments—faint odor of petroleum	2485.08	2487.33
	Bottom of Gordon sand		2487.33
10.84	Shale, dark gray, in part silty and sandy	2487.33	2498.17
.08	Sandstone, very fine-grained, light gray, tight	2498.17	2498.25
.25	Shale, dark gray	2498.25	2498.50
.25	Sandstone, very fine-grained, light gray, hard	2498.50	2498.75
1.00	Shale, dark gray, containing several thin gray sandstone seams	2498.75	2499.75
.25	Sandstone, very fine-grained, light gray, slightly micaceous, hard	2499.75	2500.00
.50	Shale, dark gray	2500.00	2500.50
.25	Sandstone, fine-grained, light gray, hard and tight, containing a few scattered rounded pebbles	2500.50	2500.75
1.25	Sandstone, fine-grained, greenish-gray, silty, grading in part into sandy shale seams	2500.75	2502.00

In the Kenamond well section, the interval between 2458 and 2480 feet is the zone in which the oil pays of the nearby larger wells occur. This interval in the Kenamond well is separated from the rest of the sandstone section by shale breaks. In some of the nearby wells the upper part of the interval, which is more porous and permeable, constitutes the oil pay and in others the lower portion carries the pay zone. Where two oil pays are present, they are usually separated by thin shale breaks, as in the Kenamond well.

Examination under a polarizing microscope of thin sections, prepared from samples of the sandstone cut from the 2458-2480 interval in the Kenamond core representing the various textural types, revealed that the low porosities and relatively low permeabilities are due to two causes. In some instances, considerable quantities of clay minerals, up to 20 percent by volume, fill the space between the quartz grains. More frequently, however, cementation by the recrystallization of quartz in a manner similar to that described by Waldschmidt[9] was observed.

Interlocking of quartz grains has resulted from the solution of silica from the sand grains at points of contact and deposition in the pore spaces between the grains in such a manner that the crystallographic orientation of the precipitation quartz is identical with that of the grains on which it is deposited. Thin sections of the sandstone from a part of the pay zone in the Gordon sand from a well in the Taylorstown field that had a porosity of 26 percent and a permeability of 320 millidarcys did not exhibit such recrystallization. The question naturally arises, did the recrystallization of the quartz occur before,

[9] Waldschmidt, W. A., Cementing materials in sandstones and their probable influence on migration and accumulation of oil and gas: Am. Assoc. of Petroleum Geologists Bull., vol. 25, pp. 1839-1879, 1941.

during, or after the period of oil accumulation. More observations will have to be made and work done to find the correct answer.

The Gordon Stray and the Fourth sands as recognized in the North Strabane area have not produced oil or gas in the area.

FIFTH SAND

The Fifth sand is an important source of gas in the North Strabane area. It consists of a very fine-grained to coarse-grained, frequently conglomeritic, light gray quartzose sandstone. Considerable shale is commonly interbedded with the sandstone, particularly in the lower part of the sandy body. The Fifth sand ranges in thickness from 5 to 47 feet in the North Strabane area, the average thickness being 28 feet.

Pay zones in the Fifth sand vary from two to nine feet in thickness. They usually occur either in the upper or middle part of the sand. Initial open flow capacities of Fifth Sand wells range from 40,000 to 200,000 cubic feet of gas per day. Wells of as high as 1,700,000 cubic feet have been reported.

SANDS BELOW THE FIFTH

Sands below the Fifth have not been of importance as a source of gas, and no oil has been encountered in them in the North Strabane area. Two of the 26 wells drilled through the horizon of the Bayard sand obtained a little gas from it. Initial open flow capacities of the wells were less than 20,000 cubic feet of gas per day. One out of the 18 wells drilled through the horizon of the Elizabeth sand obtained a little gas from this sand. Initial open flow capacity was less than 40,000 cubic feet per day. The Bayard and Elizabeth sands have been described under the section on stratigraphy. Only one well has penetrated the horizon of the Speechley sand. It found the sand to be dry.

Configuration of Sand Bodies

Much time was spent in a detailed study of the configuration of the sand bodies because it was felt that such studies may furnish a clue that may aid in the solution of some of the problems pertaining to oil and gas accumulation and the relations that such accumulations have to the sand bodies in which they are contained. If one understood the manner in which the sands were deposited, one might be able to reason why oil has accumulated only in certain places.

The thickness maps of the oil sands of southwestern Pennsylvania prepared by Matteson and Busch [10] show no direct relationship between thickness and oil or gas accumulation. An isopach map of the Gordon sand in the North Strabane area (fig. 7) furnishes no evidence that such relationships exist. Northeast-southwest elongation of the thicker portions of the sand bodies suggested that this was the general trend of the shore line at the time of deposition.

If oil accumulation is associated with sand deposition, it is possible that the configuration of the sand bodies may bear some relation to oil accumulation. With this in mind, several maps were prepared showing the configuration of the oil-bearing sands. These maps were

[10] Matteson, L. S., and D. A. Busch, Oil-Bearing sands in southwestern Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Sp. Bull. 1, 1944.

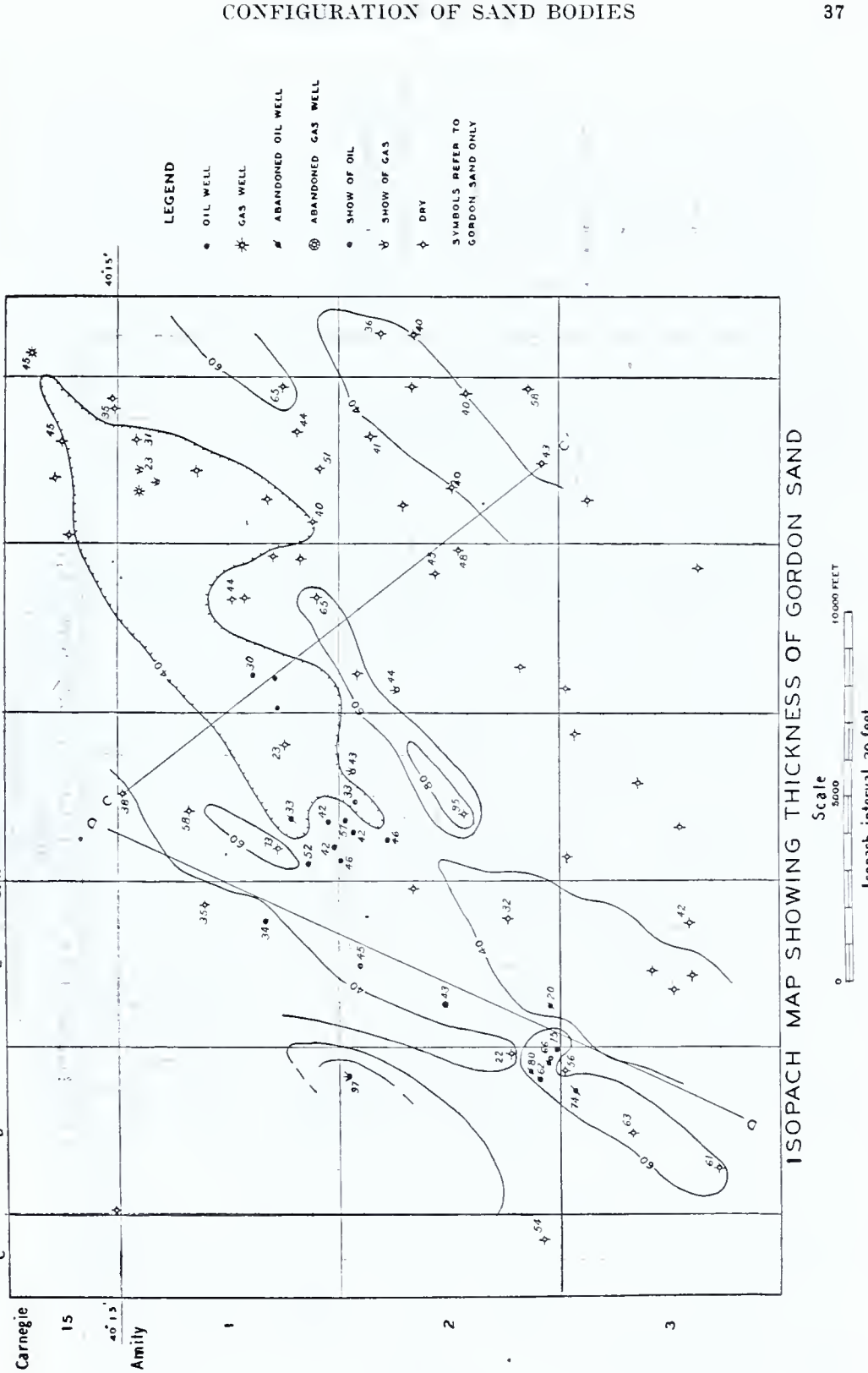

LEGEND
OIL WELL
GAS WELL
ABANDONED OIL WELL
ABANDONED GAS WELL
SHOW OF OIL
SHOW OF GAS
DRY
SYMBOLS REFER TO GORDON SAND ONLY
ISOPACH MAP SHOWING THICKNESS OF GORDON SAND
Scale
5000
0
10000 FEET
Isopach interval 20 feet
Carnegie
Amily
80°10'
40°15'
C
D
E
F
G
H
I
1
2
3

Figure 7

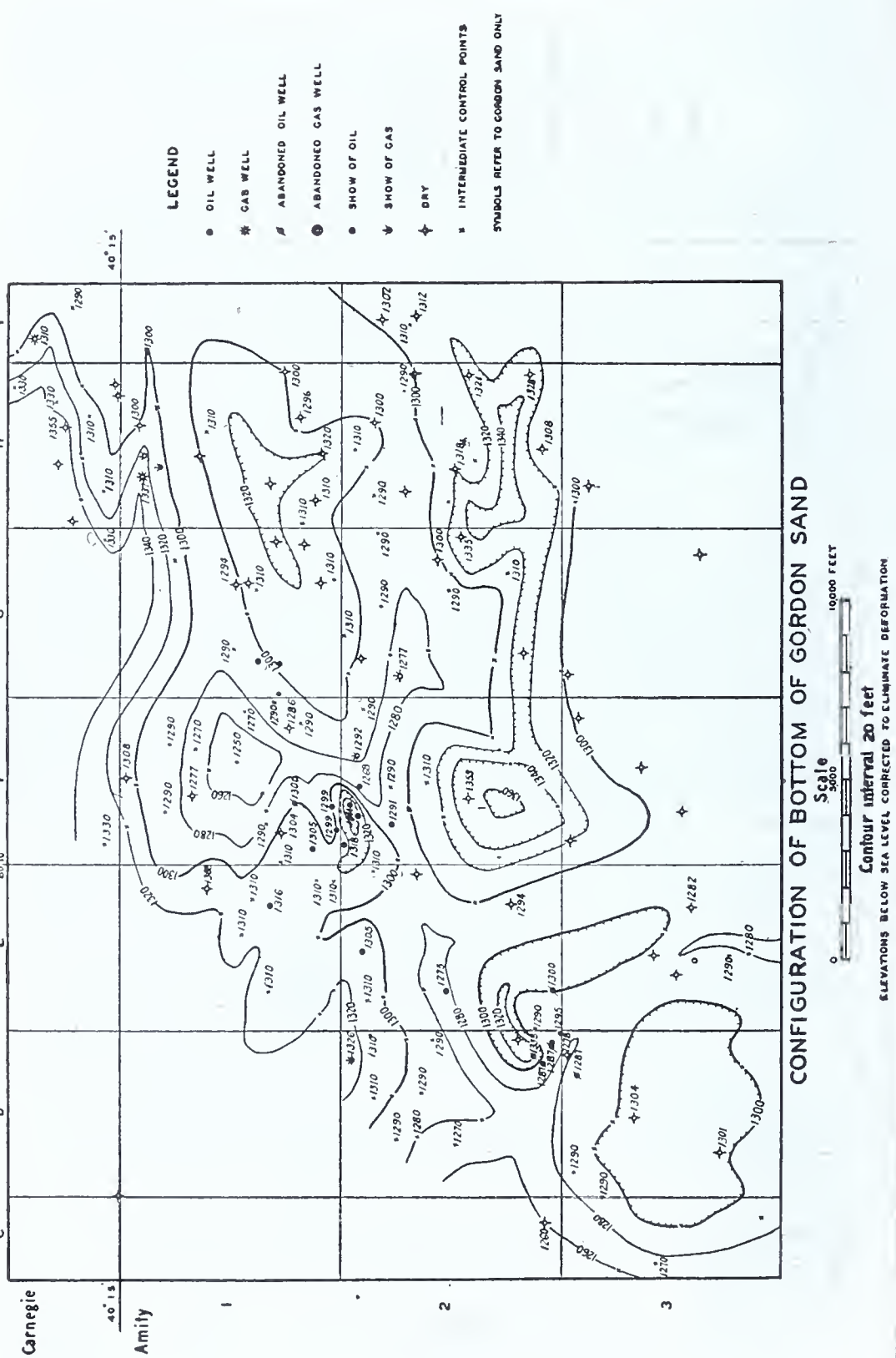

LEGEND
OIL WELL
GAS WELL
ABANDONED OIL WELL
ABANDONED GAS WELL
SHOW OF OIL
SHOW OF GAS
DRY
INTERMEDIATE CONTROL POINTS
SYMBOLS REFER TO GORDON SAND ONLY
CONFIGURATION OF BOTTOM OF GORDON SAND
Scale
10000 FEET
Contour interval 20 feet
ELEVATIONS BELOW SEA LEVEL CORRECTED TO ELIMINATE DEFORMATION
Carnegie
Amity
40°15'
80°10'
C
D
E
F
G
H
I
1
2
3

Figure 8

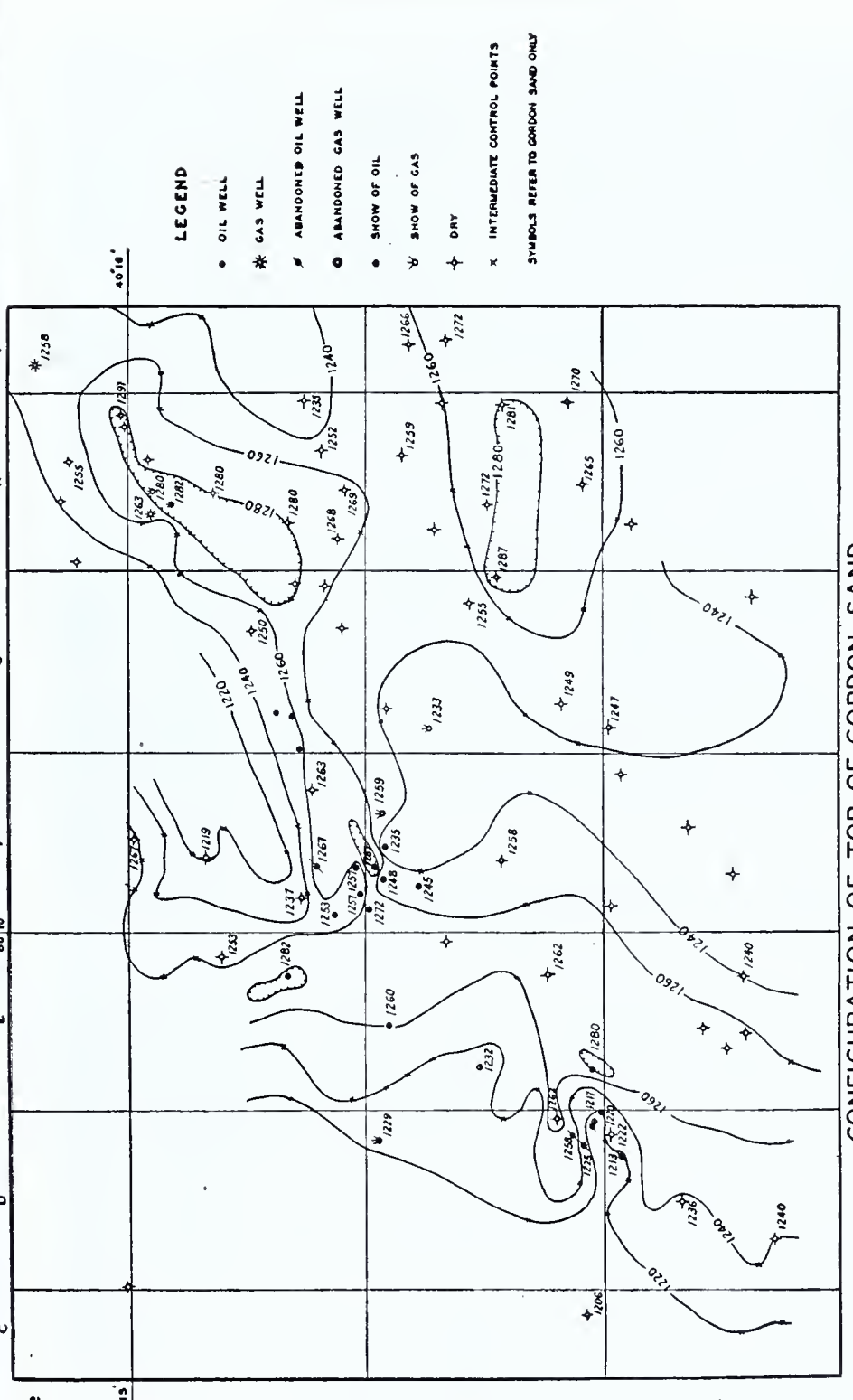
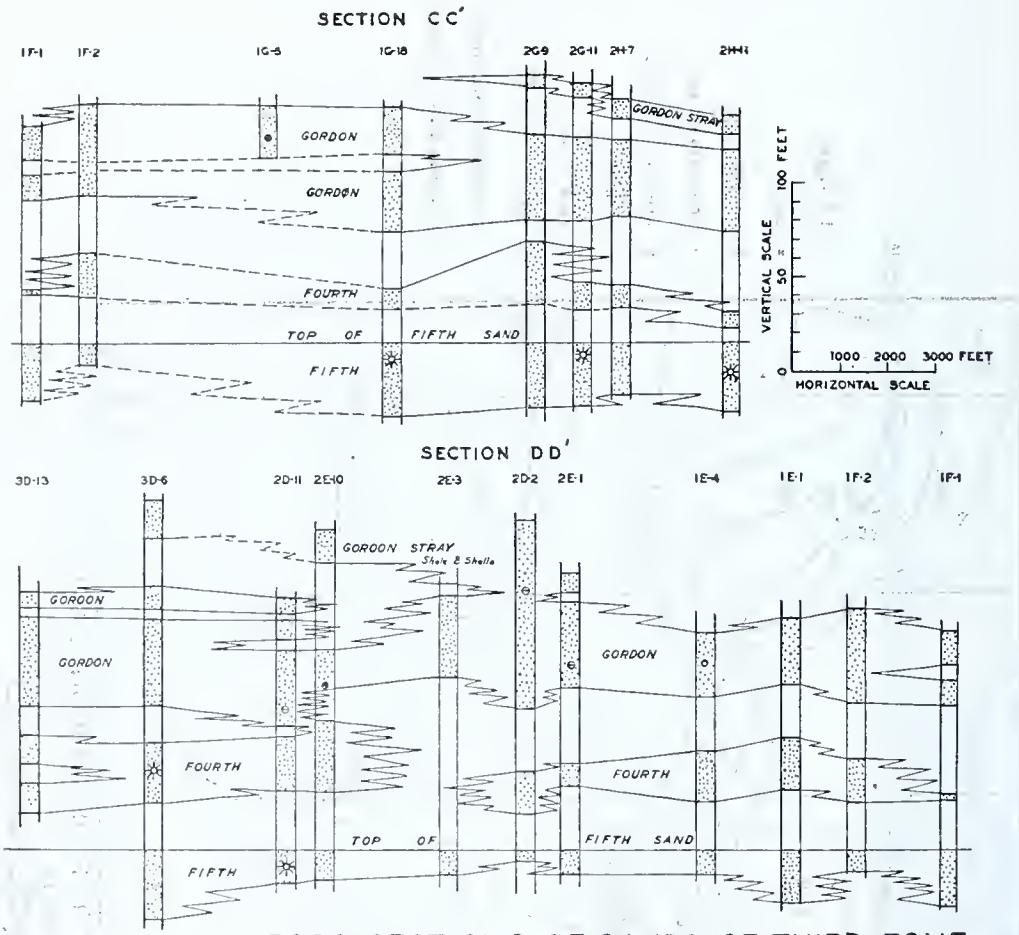

LEGEND
OIL WELL
GAS WELL
ABANDONED OIL WELL
ABANDONED GAS WELL
SHOW OF OIL
SHOW OF GAS
DRY
INTERMEDIATE CONTROL POINTS
SYMBOLS REFER TO GORDON SAND ONLY
CONFIGURATION OF TOP OF GORDON SAND
Scale
0
5000
10,000 FEET
Contour interval 20 feet
ELEVATIONS BELOW SEA LEVEL CORRECTED TO ELIMINATE DEFORMATION
Carnegie
Amity
40°15'
40°18'
80°10'
C
D
E
F
G
H
I
1
2
3

Figure 9



INTERPRETIVE CROSS SECTIONS OF SANDS OF THIRD ZONE OF THE CONEWANGO GROUP

Figure 10

made by correcting present sea-level elevations of the sand surfaces to eliminate the structural deformation shown on the top of the Loyalhanna member of the Greenbrier group. The procedure employed has been explained in the section on method of investigation. The resulting maps show very nearly the shape of the sand bodies at the time of deposition. The surfaces depicted are not necessarily surfaces of time equivalence as sand deposition may have started or ceased in one area sooner than in another. The configuration maps show less pronounced northeast-southwest trends than do the thickness maps. The maps of the configuration of the bottom and the top of the Gordon sand (figs. 8 and 9 respectively) show a series of low areas in the sand from southwest to northeast paralleling the trend noted on the isopach map. However, no relation is apparent between the configuration of the sand and the accumulation of oil and gas.

In conjunction with the configuration maps of the Gordon sand, detailed cross sections were prepared of the sands in the Third zone of the Conewango group, using the top of the Fifth sand as a datum plane, in an effort to understand more clearly the relations of these sands to one another. Two of these sections are presented in figure 10.

The locations of these sections are given in figure 7. Cross section CC′ was drawn nearly at right angles to the apparent trend of the shore line. This section shows diagrammatically the interfingering nature of the sands and shales. The Gordon sand in the wells to the west of well 2G9 is split into two portions with the rich pay zone in the J. Gregar well of Charles E. Young (1G5) in the sand that overlaps the thin shale member. Cross section DD′ is drawn almost parallel to the shore line trend and shows that the distribution of the sand bodies is very irregular along the shore line. From this it may be concluded that the shore line was not straight and uniform but was irregular and that deposition along the shore varied considerably from place to place. During the process the focus of deposition undoubtedly shifted continually. For example, the extremely thick Gordon sand in wells 2D2 and 2F12 suggest that they lie in a zone that was extremely favorable for sand accumulation during this interval of deposition.

The North Strabane area is too small to give a clear concept of the regional nature of the oil-bearing sands. However, Matteson and Busch [11] have shown that to the west the sands thin and die out in the marine shales with which they interfinger. Shale tongues extending eastward thin and die out in the sand. These interbedded tongues of marine shales and littoral sands suggest that there was an oscillation of the shore line seaward and landward due probably to the combined effects of variation in the amount and kind of material being supplied from the landward side, variations in the rate of subsidence, and perhaps minor emergencies occurring during an epoch of gradual submergence.

It has been observed that there may be a relation between pay zones and their position in sands with respect to shale breaks. A detailed study of this relation over a much larger area with more complete well records will be necessary to clarify these relations. Plans are being made to carry out such a study.

The possibilities are strong that oil and gas accumulations are intimately associated with the interfingering of marine and littoral deposits. Certain characteristics of the interfingering may have a constant relationship to accumulation of petroleum. If this relation can be established it may serve as a means to predict more favorable zones for prospecting.

Though a detailed study of the configuration of the sand bodies in the North Strabane area has not led to any conclusions concerning the control of petroleum accumulation, it has suggested the need for further study of certain relations in a larger area of more comprehensive subsurface information. Better logging of the sand sections by the driller, including the recording of the exact positions of all pay zones and shale breaks, and information concerning the character of the sand and the nature of the fluids encountered in it and their

[11] Matteson, L. S., and D. A. Busch, op. cit.

amount, are essential for a better understanding of the sand and the accumulation of oil and gas in it.

Description of Pools

Seven small oil pools and twelve small gas pools have been developed in the North Strabane area. This does not include the abandoned gas field in the northwestern part of the area concerning which no information was obtained. The pools are shown on plate 1. Oil in commercial amounts has been found in the Gantz, Fifty-foot, and Gordon sands. Gas occurs in the First Salt, Big Injun, Gantz, Fifty-foot, and Fifth sands. A study of the distribution of these pools on the map, plate 1, shows that it was only through the relatively close spacing of the wells that all of these pools were discovered.

FIRST SALT SAND POOLS

Two gas pools have been developed in the First Salt sand, both in the eastern part of the area. One includes about 60 acres and the other 440 acres. The First Salt sand pools are irregular in outline and no trend is apparent.

BIG INJUN SAND POOLS

The Big Injun sand has produced gas in only three very small areas, 40, 60 and 70 acres in extent. The pools are markedly elongated in a nearly east-west direction, but do not appear to have any particular alignment with respect to one another.

GANTZ SAND POOLS

Four small oil pools have been opened in the North Strabane area and one gas pool in the Gantz sand. The four oil pools cover 90, 220, 300, and 370 acres, or a total area of 980 acres. The gas pool includes an area of 750 acres. The Gantz sand pools, although somewhat irregular in outline, with one exception, tend to be elongated in a northeast-southwest direction and also appear to be aligned with respect to one another along that direction. One small oil pool in the Gantz sand is elongated in a nearly east and west direction.

FIFTY-FOOT SAND POOLS

Only two very small gas pools have been developed in the Fifty-foot sand, one of which comprises 35 acres and the other 50 acres. A Fifty-foot Sand oil pool extends into the area from the southwest. About 275 acres in the North Strabane area are included.

GORDON SAND POOLS

Only one small Gordon Sand oil pool, covering about 90 acres, had been developed in the North Strabane area prior to the discovery of the pool one mile southeast of the Hill Church in the spring of 1945. The limits of the new Gordon Sand pool have been only partly defined.

On plate 1 and the five Gordon Sand maps (figs. 4, 5, 7, 8, and 9) it will be noted that all of the Gordon Sand production developed to date is confined to a relatively narrow strip This trend extends from the small oil pool opened in 1924 in the southeast corner of rectangle 2D to the two gas wells, 1H5 and 1512, that have produced from the Gordon sand in the northeast corner of the area. The small pools opened by wells drilled in 1945 and 1946 are included in this trend.

An examination of the five Gordon Sand maps indicates that there is room for further exploration along this trend. However, it is possible that more wells have been drilled through the Gordon sand than are shown on these maps, since only those wells have been included that are definitely known to have been drilled through the Gordon sand. Some of the others shown on plate 1, for which no records are available, may also have been drilled through this sand.

On the southeast side, the edge of the new pool is defined by three dry holes and one small oil well. On the northwest side, the J. T. Yoney No. 1 well (1E4) suggests that the pool may be extended in that direction to include this well. Both the southwest and northeast of this pool are areas worthy of further prospecting. Three Gordon Sand wells completed in 1946, the Joseph Gregar (1G5), the E. G. Walker (1G7), and the George Markle (1G9) make the northeasterly direction appear particularly favorable. The fact that the E. G. Walker No. 1 well (1F7), located between the main pool and the above group, was dry in the Gordon sand makes it appear possible that there are two pools rather than a single one in this area.

FIFTH SAND POOLS

Four Fifth Sand gas pools have been developed in the North Strabane area. These include areas of 60, 150, 400, and 630 acres, or a total of 1,240 acres. The Fifth sand pools exhibit a pronounced elongation in a northeast-southwest direction.

ACKNOWLEDGMENTS

For the field data and the collection of the drill cutting samples upon which this report is based, the writers are indebted to the following companies and individuals: Keystone Gas Company, Peoples Natural Gas Company, Wasco Fuel Company, R. E. Bayles, Edward Beedle, George J. Donaldson, Jr., Robert R. Murray, Ross Paul, E. H. Tague, L. R. Vezic, and Charles E. Young. J. Byron Jones, formerly a member of the Pennsylvania Geological Survey staff, supervised the taking of the Kenamond core and took the saturation samples. E. M. Tignor of the Franklin Field Office of the United States Bureau of Mines at Franklin, Pa., made the permeability, porosity, and oil saturation determination on the samples from the Kenamond core. Miss Virginia Fairall of the Pennsylvania Geological Survey staff did the drafting.

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CORE ANALYSIS DETERMINATIONS OF SAMPLES OF DIAMOND CORE FROM J. L. KENAMOND No. 1 WELL[1]

By

E. M. Tignor[2]

Introduction

Core-analysis determinations of diamond core samles furnished by the Pennsylvania Geological Survey were made by the Federal Bureau of Mines in the laboratory of the Petroleum Field Office, Franklin, Pa. Results of these determinations are given in Table I.

Methods Used in Core-Analysis Determinations

Permeability. Permeability determinations of the core samples were made in accordance with A.P.I. Code 27, second edition.[3] All permeability measurements were made parallel to the bedding plane. A test specimen was cut from each sample with a power-driven steel disk saw set with diamond inserts. Water was used for cooling and washing away the cuttings. The specimens were thoroughly cleansed in a Soxhlet extraction apparatus, using chloroform as the solvent, and dried at 220° F. Dry-filtered air was used as the test fluid. A precision mercurial barometer and mercury manometers were used to measure pressures. A precision gas burette, in a water jacket, was used for measuring gas volumes by controlled displacement of mercury.

Porosity. The procedure used for effective porosity determinations was a modification of the Barnes method.[4,5] After the cleansed and dried specimens had been weighed separately they were transferred to a suction flask provided with connections that allowed tetrachloroethane to enter the bottom of the flask at the proper time. First the flask containing the specimens was evacuated to an absolute pressure of 1 to 2 mm. of mercury. This pressure was maintained for 30 minutes with the vacuum pump. Then the flask outlet cock was closed and the inlet cock opened so that the tetrachloroethane would enter the flask slowly until the specimens were covered; the flask inlet cock was then closed. The resulting reduced pressure condition was allowed to prevail for an additional 30 minutes before air was admitted to the flask and the saturated specimens removed for weighing. The pore volumes were obtained by dividing the weights of the absorbed solvent by the solvent's specific gravity. The bulk volumes of the specimens were determined by weighing the mercury displaced from a steel pycnometer by each specimen, and dividing this weight by the specific gravity of mercury.

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[1] Published by permission of the Director, Bureau of Mines, U. S. Department of the Interior.

[2] Petroleum engineer, Petroleum Field Office, Bureau of Mines, Franklin, Pa.

[3] American Petroleum Institute, Standard Procedure for Determining Permeability of Porous Media: Code 27, 2d ed., April, 1942, 21 pp.

[4] Barnes, K. B., A Method for Determining the Effective Porosity of a Reservoir-Rock: Pennsylvania State College, Mineral Industries Experiment Station, Bull. 10, 1931, 12 pp.

[5] Proceedings, Third Pennsylvania Mineral Industries Conference, Petroleum and Natural Gas Section, Pennsylvania State College, School of Mineral Industries, Bull. 12, 1933, pp. 117-118.

TABLE 1. Core data—J. L. Kenamond No. 1, North Strabane Twp., Washington Co., Pa.

Depth, feet	Permeability, millidarcys	Porosity, percent	Saturation Percent pore volume		Oil content, barrels per acre-foot	Chloride content of water found in core samples, p.p.m.
			Oil	Water		
2427.7	0.3	2.49	25.62	72.02	50	
2428.4	.9	2.28				
2432.5	.3	3.62	15.89	80.41	45	
2443.1	1.5	4.47				
2448.1	.4	3.54				
2450.0	1.0	7.87				
2452.7	.7	4.59				
2459.5	9.6	6.57				
2462.1	11.6	11.21				
2462.7	3.9	11.19				
2462.8	96.0	10.11				
2465.7 [1]	.9	8.14	25.59	14.22	162	
2468.3 [2]	2.5	11.69	24.86	27.16	226	111916
2469.6	1.9	10.31				
2470.4 [1]	.8	9.24	17.16	32.60	123	
2472.2	1.1	8.48				
2473.1 [2]	.9	9.16	14.47	45.08	103	
2475.6	3.2	7.72				
2477.1	1.0	8.37	25.80	41.95	168	129271
2478.5	71.5	7.82	22.60	13.09	137	21815
2479.5	1.1	7.68				
2484.2	.4	4.52				
2486.0	.4	5.55				

[1] Sample was not placed in air-tight container until 36 hours after its removal from core barrel.
[2] Sample was not placed in air-tight container until 12 hours after its removal from core barrel

Oil and Water Saturation. Oil and water saturations were determined by the method described by Taliaferro and Spencer,[6] except that the oil extraction was completed in a simultaneous water-determination and oil-extraction apparatus designed by Bureau of Mines engineers and illustrated in figures 3 of an article [7] on secondary recovery research at the Petroleum Experiment Station, Bartlesville, Okla. Toluene was used as the solvent. In this method the part of the core sample to be used for a saturation determination was broken into fragments with a small rock crusher and placed in an alundum thimble that previously had been dried in an oven at 220° F., cooled in a desiccator, and weighed on an analytical balance. To prevent the loss of any sand grains from the thimble during extraction and handling, a small quantity of dry cotton was used in the top of the thimble. This cotton was weighed with the thimble and included in the tare weight. The filled thimble was weighed immediately and placed in the simultaneous water-determination and oil extraction apparatus, to which the solvent, toluene, had been added. When heat was applied and the distillation process started, the water and toluene vapors were driven to the watercooled condenser, wherein they condensed and ran back into the graduated water trap. The water settled to the bottom of the trap as the toluene reflux overflowed from the trap onto the core sample in the thimble.

After the extraction was completed and the apparatus had cooled to room temperature, the volume of water in the trap was recorded. The thimble, extracted sample, and cotton were then dried, cooled, and weighed, The volume of oil extracted was calculated by subtracting the weight of water found in the sample from the total loss in weight during extraction and dividing the remaining weight by the specific gravity of oil produced from the formation rock from which the core was taken.

The apparent density of the saturation sample after extraction is assumed to be the same as the apparent density of the adjacent porosity specimen as determined by the ratio of its weight to its bulk volume:

$$\text{Bulk volume of saturation sample, ml.} = \frac{\text{Weight of extracted saturation sample, m.}}{\text{Apparent density of porosity specimen, gm./ml.}}$$

Percentage of oil saturation was calculated as follows:

$$\text{Oil saturation, percent} = \frac{\text{Volume of oil in the sample, ml.}}{(\text{Bulk volume of sample, ml.}) \times (\text{porosity, percent})} \times 10{,}000.$$

Chloride Determination. The chloride content of the interstitial water found in the core samples was determined by the method suggested by Schilthuis. A 15- to 25-gram sample of crushed unextracted core sample was weighed, and 100 ml. of distilled water and

[6] Taliaferro, D. B., and Spencer, G. B., A Method for Determining the Water Content of Oil Sands: Bureau of Mines Rept. of Investigation 3535, Sept., 1940, 11 pp.

[7] Bauer, G. G., Secondary Recovery Research Stressed at Bureau of Mines' Bartlesville Experiment Station: Producers Monthly, vol. 10, no. 3, Jan., 1946, pp. 11-14.

[8] Schilthuis, R. J., Connate Water in Oil and Gas Sands: Trans Am. Inst. Min. and Met. Eng., Petrol. Devel. and Technol., vol. 127, 1938, pp. 199-214.

5 ml. of saturated potassium nitrate solution were added. The purpose of the latter was to cogulate clay particles. The mixture was heated just to the boiling point, then allowed to cool before it was filtered. The filtrate was titrated with standard 0.1 normal silver nitrate solution, using potassium chromate as an indicator. When the milligrams of chlorine in this sample had been determined, the chloride content of the interstitial water in the same core sample was calculated as follows:

$$\text{Chloride, Parts per million,} = \frac{\text{Chlorine in chloride content sample mg.}}{\dfrac{\text{Water in saturation sample, ml.}}{\text{Initial weight of saturation sample, gm.}} \times \text{Weight of chloride content sample, gm.}} \times 1{,}000.$$

TABLE 3, WELL RECORDS

MAP NUMBER	15D-7	15H-3	15H-4	15H-5	15H-6	15H-7	15H-10	15H-11	15I-1	15I-2	15I-5			
NAME OF WELL	Alexander	E K Lewis #2	J.R.McNary #3	G Yatsko #1	North Strabane Water Co	E K Lewis #1	Leonard #2	Leonard #1	Speir Heirs	J L McNary #2	F&T. Anthony			
OWNER	Canonsburg Steel & Iron	Wasco Fuel Co	Wasco Fuel Co	Wasco Fuel Co	Wasco Fuel Co	Wasco Fuel Co	Wasco Fuel Co	Wasco Fuel Co	Lyle & McCloy	Mfg L & H	Wasco Fuel Co			
DATE COMPLETED		1929	1928	1921	1927	1926	1927				1937			
ELEVATION	1020	1008	1050	996	998	996	986	985	1060	1050	1020			
PITTSBURGH COAL		254-260	300-306	238-242	240-246	240-246			231···	245-251	234-240			
MURPHY SAND					420-442						440-460			
SALTSBURG SANDSTONE						660-720					650-670			
LITTLE DUNKARD SAND		780-830			705-750	775-825				780-835	775-808			
BIG DUNKARD SAND					860-975						840-875			
LOWER FREEPORT COAL				935-940			1040-1045							
FIRST GAS SAND	754···				1020-1043									
FIRST SALT SAND		1175-1240	1250-1296	1165-1260	1162-1200 water 1230-1240	1140-1230 water at 1215	1310-1348 2 boilers of water	1172-1220	1150-1200	1140-1185	1142-1237 300 MCF at 1220			
SECOND SALT SAND										1220-1250 water 1240				
MAXTON SAND									1370-1400 water	1367-1372				
BIG LIME		1375-1415	1405-1445	1360-1405	1290-1395	1330-1392			1400-1430	1372-1410	1356-1385			
BIG INJUN SAND		1415-1645 GS 1605 at 1525	1445-1670 G 1518 1577 1590-1606 IRP 445 lbs	1405-1646	1395-163[illegible]	1392-1630	1504-1750	1385-1616 GS 1448		1417-1650 GS 1521	1385-1635 GS 1437			
SQUAW SAND		1730-1815 GS 212 MCF 1795 1800		1690-1710	1722-1780	1735-1770 GS 1766	1800-1870				1774-1790			
MURRYSVILLE SAND		1980-2010			1960-1986	1952-1980	2070-2100			1990-2050	1961-1980			
GANTZ SAND	1802	2120··· 1# table/day 3.48 mcf 250 MCF gas with oil	2153-2195	2111-2148	2109-2155 O at 2123½	2105-2143 O 2125	2217-2245 3/4 boiler overnight	2063···	2136-2165	2123-2153	2104··			
FIFTY-FOOT SAND	1850-1906 G 1854-1864		2197-2230	2155-2200 OEGS 2158, 2163 1# 30 min/day	2157-220[illegible]	2148-2187 Soft 2178-2177	2250-2317	··· 2152	2175··· O with water 2174 2185	2153-2182 O.S 2168	···· 2194 OS w/h with water 2148 2191			
UPPER NINEVEH SAND							2375-2400			2235-2255				
LOWER NINEVEH SAND										2280-2300				
GORDON STRAY SAND	2035···						2448-2485			2340-2360				
GORDON SAND	····2095		2400-2495 break 2445-2460 bottom part hard 8				2495-2530			2375-2420 G 2397				
FOURTH SAND	2123 ··						2550-2570			2450-2463				
FIFTH SAND	2131···		2520-255[illegible] OS 2535-2540				2582-2615	Gas		2492-2527 G.	G 40 MCF at 2416 IRP 200 lbs			
TOTAL DEPTH		2155	2575		2297	2187	2700		2198	2325	2681			
DEEPEST SAND DRILLED		Gantz	Fifth	Elizabeth	Fifty-foot	Fifty-foot	Fifth	Fifth	Fifty-foot	Fifth	Fifth			

TABLE 3, SHEET 2

MAP NUMBER	1E-1	1E-4	1F-1	1F-2	1F-3	1F-4	1F-5	1F-6	1F-7	1F-8	1F-9	1F-10	1G-2	1G-3
NAME OF WELL	C. Winnette	J T Yoney #1	H H White	G P Schmieler	Sam White #2	T S Grier #2	J Arblaster	T S Grier #1	E G Walker #1	G Boyle #1	G Achroyd #1	G Boyle #2	J Gregar	J P Manes #1
OWNER	C E Young	R Murray & Co.	C E Young	R Murray & Co.	C E Young	C E Young	E Beedle	C E Young	C E Young	E Beedle	C E Young	E Beedle	Keystone Gas	Philadelphia
DATE COMPLETED	1944	1946	1946	1946	1944	1945	1938	1944	1945	1945	1945	1945	1940	
ELEVATION	1187	1253	1145	1190	1167	1200	1189	1114	1161	1207	1316	1189	938	955
PITTSBURGH COAL	406-413	451-455	395-400	412-416	401-407	470-474	405-411	360-367	395-401	448-454	555-560	406-410	181-189	222---
MURPHY SAND	595-620		526-536		575-595		580-605				700-735	600-612		
SALTSBURG SANDSTONE	780-800	770-810		810-827	840-935		780-800				945-965			
LITTLE DUNKARD SAND	850-945 with breaks					945-960				935-946		920-935		
BIG DUNKARD SAND	1035-1090	1038-1075	1020-1045	1031-1118	1040-1060	1020-1098	1010-1100	950-1005	1010-1035		1190-1215	1032-1065	788-835	
LOWER FREEPORT COAL				1118-1120		1165-1168	1100-1103	1030-1034	1084-1087		1251-1256		861-864	
FIRST GAS SAND	1190-1235	1218-1306 break with water 1260	1163-1223	1185-1220				1110-1135	1170-1220 GS 1191-1197, 76 MCF	1210-1265	1400-1425	1210-1260	948-972	
FIRST SALT SAND	1335-1430 water 1380	1365-1425 500 MCF, blowing down overnight, filling water	1325-1388	1333-1420 breaks 1382-1385 water 1400	1330-1420 breaks 1365-70 water 1375	1381-1425 water	1340-1424 water	1240-1290	1318-1360 GS 1331	1355-1465 water 1437	1469-1570	1300-1314	1105-1130	
SECOND SALT SAND		1437-1475		1445-1475		1461-1495		1293-1357 G 247 MCF at 1315	1380-1406			1340-1397	1133-1198	
MAXTON SAND									1460-1495 GS 1468-1475 522 MCF showed out					
BIG LIME		1552-1574	1465-1545 broken	1531-1563	1470-1510 GS 1492-1498 blew out	1590-1608		1440-1485	1495-1553		1670-1703		1313-1348	
BIG INJUN SAND	1547-1785 GS 1636-1638 1663-1666	1574-1850 breaks 1630 & 1680	1545-1813	1563-1805 break 1628-1631 GS & GCS final 1681-90	1570-1574, 1580, 30 MCF 1 P 420 bbls	1608--- GS 1685-1688 536 MCF	1543-1785 GS	1485-1720 break 1613 GS 1688	1553-1785	1575-1805	1703-1890 break 1736-1790	1553-1788 water 1360 GS 1805-1820	1348-1595	
SQUAW SAND			1922-1941 GS 1935	1930-1955					1885-1913		2025-2060			
MURRYSVILLE SAND		2120-2140		2090-2145				2000-2135				2100-2270 GS 2248-2260		1895---
GANTZ SAND	2254-2328 GS 2307-2309	2306-2355 GCI soft break 2333 55	2255-2296 GS & GCS 2264-2266 1 P 350 bbls / day	2251-2291			2243--- GS 2253 GCI 2260 Gas 2311 Final 2288 G 4.6 MCF	2175-2240 GS 2210	2240-2319 GS 2265-2270 G 8.15 MCF 2316	2273-2335 GS 2286 GS 2335	2395-2458 GS 2412 42 MCF	2270-2348	2041-2103	2023---
FIFTY-FOOT SAND	2350-2370	2355-2400 broken	2308-2365	2300-2340			2362--- Gas	2265-2300 GS near top	2335-2353	2347-2387 red shale break 2366-2370	2472-2510	2348-2385	2116-2148	2086---
UPPER NINEVEH SAND		2452-	2410-2430	2411-2437			2413--- GB	2365-2380	2400-2410	2437-2450	2555-2570		2193-2205	
LOWER NINEVEH SAND	2442-2455	Nineveh sands & Gordon Stray merged					2440-2460				2575-2605			
GORDON STRAY SAND	2478-2496	--2541									2630-2640		2277-2294	2263--
GORDON SAND	2500-2535	2556-2590 GCI 2571-2574	2512-2550 break 2529-2537	2482-2540			2480-2553	2452-2485 GCI 2472-2476 1 P 10 bbls	2516-2539	2528-2580 GS 2550 Oil 2572 4.8 bbls/hr	2660-2702 GS 2693 break Oil 2678-2686 1 P 300 bbls/day At 3114 Frac	2510-2552 GB 2533 break Oil 2544-2560 At 3114 Frac	2298-2342	2313---
FOURTH SAND	2563-2590	2618-2645	2597-2600	2570-2593			2565-2591 break 2576-2582	2500-2530	2570-2590				2365-2389	2401--
FIFTH SAND	2622-2649	2670-2682	2626-2656	2617-2629			2624-2654 GS 2641-2644	2565--- GS 2574 Gas 24, 1 MCF	2607-2638	2652-2665			2412-2446 GS 2427	2450--
TOTAL DEPTH	2910	2688	2671	2655	1580	1691	2779	2687	2778	2801	2712	2552	3503	
DEEPEST SAND DRILLED	Beyond	Fifth	Fifth	Fifth	Big Injun	Big Injun	Fifth	Fifth	Fifth	Fifth	Gordon	Gordon	Elizabeth	Fifth

MAP NUMBER	1G-4	1G-5	1G-7	1G-8	1G-9	1G-10	1G-13	1G-15	1G-18	1H-1	1H-2	1H-3	1H-4	1H-5
NAME OF WELL	J L Fulton	J Gregor #1	E G Walker #2	G Markle #2	Geo Markle #3	G. Markle #1	J P Mones #2	Washerbough #1	G. Martin #1	J R McNary #2	J Yatsko #2	J R McNary #1	J R McNary #4	W JM Gowern #1
OWNER	C E Young	C.E Young	C E Young	Keystone Gas	Keystone Gas	Keystone Gas	Philadelphia	Jefferson Gas	Keystone Gas	Wasco Fuel Co.	Wasco Fuel Co	Wasco Fuel Co	Wasco Fuel Co.	Wasco Fuel Co
DATE COMPLETED	1946	1946	1946	1946	1946	1945			1940		1944	1920	1934	
ELEVATION	1196	1127	1227	1218	1136	1145	1010	920	1003	1107	1158	1136	1077	1101
PITTSBURGH COAL	434-437	359-364	445-450	440-445	367-372	368-373	293---	190 --	230+ 236	340-347	392-398	359-365	297-305	320-326
MURPHY SAND										470-520				
SALTSBURG SANDSTONE	812-835	730-755	827-850	844-900	750-808	761-788 GS 762 100 MCF				740-765				
LITTLE DUNKARD SAND	925-940	850-870	936-955	930-945		870-895				880-935	927-946	894-930	830-865	
BIG DUNKARD SAND	1010-1071	940-985	1065-1100	1015-1137	949-1048	974-1040			836-880 GS 864 RCB 300 MCF blew out	970-1020	1020-1035	992-1048		880-910
LOWER FREEPORT COAL									926-930 water					
FIRST GAS SAND	1215-1243	1115-1169		1235-1250	1128-1180				1090-1110		1210-1248			1075-1190
FIRST SALT SAND	1340 G 1345, 500MCF	1284-1325 G 9 1289, 1287 75MCF	1355-1430 break 1370-1377	1335-1450 water 1392	1287-1392 break 1332 GS 1332	1285-1340 GS 1303-08, 150MCF water 1324	1180---		1170-1225 water 1200-03	1244-1330	1315-1375 break 1336-1350	1272-1312	1225-1242	1255-1350 water 1310
SECOND SALT SAND		1335-1387 water 1335-1381	1449-1467			1352-1395 water 1380							1246-1292	
MAXTON SAND		1437-1465 GS 1453, 1457 very faint		1517-1534 water 1530	1455-1474	1460-1465			1354-1360					
BIG LIME		1466-1523	1590-1610	1548-1590	1493-153	1495-1530			1382---	1430-1482		1480-1515	1410-1458	1440-1472
BIG INJUN SAND		1523-1760	1610-1840	1590-1825 break 1665-1671 G 1655-65, 50MCF	1530-1774 break 1585-1590	1530-1775 break 1593-1600			--1620 break 1644 49 GS 1648 43	1482-1710	1507-1790 GS 1703 98.4 MCF GS 1688	1515-1759	1458-1697	1472-1735 break 1530-1539
SQUAW SAND		1780-1826		1925-1950	1820-1848	1874-1894			1670-1685	1820-1840	1835-1860	1805-1852		1810-1830
MURRYSVILLE SAND			2050-2235							2040-2070	2102-2130	2040-2112		2005-2040
GANTZ SAND		2209-2295	2302--- GS 2304 2330	2291-- GS 2304 85, 50MCF Oil 2315 18, 2331-35	2228-2240	2243 Oil 2242 GS 2251-85 1 P 75 bbls / day	2110--		2076-2150 GS 2113-17, 111 MCF blew out	2180-- GS 2210-09 Oil 2218 121 Richard sand show	2242-2291 DRGS 2246 72 water DS 2291 2300 water	2208-2267 G 2235-2239 O 2251-2256	2150-2192 GS RGS 2173 78 10 MCF	2180 G 2200 O 2205
FIFTY-FOOT SAND		2305-2335	--2390		2240-2317 Oil 2243 GS 2311 80 TP 25 bbls/day				2158-2190 red shale 2163-66	--2297	2291-2355	2267-2337 Oil 2271	2196-2261	2298 Gantz & Fifty Foot merged
UPPER NINEVEN SAND		2358-2400	2446-2470		2321-2339				2240-2253			2375-2385		2325-2335
LOWER NINEVEN SAND					2382-2402									2340-2360
GORDON STRAY SAND		GS & OS 2464 faint	2526-2538		2458-2470							2455-2470	2404-2417	
GORDON SAND		2474-2504 Oil 2496	2545-2599 Oil 2573 2578		2477-2524 break 2509 2514 Oil 2491 2512		2376---		2320-2385 break 2345-53		2470-2544 merged with Gor Stray GS 2503 Oil show	2495-2518 GS 2498	2427-2458	2454 G 2455-2472 O 2465
FOURTH SAND									2415-2425		2576-2590	2556-2562	2486-2498	
FIFTH SAND							2479 Gas	2380---	2443-2482 G 2448 2455 200 MCF		2611-2645	2593-2618 GS 2599	2525-2553 G 2538 GS 2552	
TOTAL DEPTH	1350	2526	2607	2340	2526	2288		2403	3651	2297	3005	2623	2682	2898
DEEPEST SAND DRILLED	First Salt	Gordon	Gordon	Gantz	Gordon	Gantz	Fifth	Fifth	Speechley	Fifty-foot	Elizabeth	Fifth	- Fifth	Gas 2660-70 Beyond 5" Elizabeth

TABLE 3, SHEET 4

MAP NUMBER	1H-6	1H-8	1H-9	1H-10	1H-11	1H-12	1H-13	2C-2	2D-2	2D-5	2D-6	2D-7	2D-11	2D-12
NAME OF WELL	J.V. Manes #1	J.J. Manes #1	J. Hixon	J.C. Beabout	J.J. Manes	J. Ross #1	J. Ross #2	E. Carothers	D. Woodruff	J.S. Mansfield	Lutton #3	Lutton #5	Lutton #8	Lutton #1
OWNER	Philadelphia	Philadelphia	Keystone Gas	Keystone Gas	Keystone Gas	Keystone Gas	Keystone Gas		Woodruff & Co		J. McCloy	J. McCloy	E.H. Teague	J. McCloy
DATE COMPLETED			1937	1937	1937	1938	1938	1925	1946	1925	1925	1925	1938	1924
ELEVATION	1025	995		1156	1191	961	1131	1038	1302		1236	1275	1213	1228
PITTSBURGH COAL	270 ---	211 ---	310-315	348-354	394-400	205-210	345-351	141-148	444-450	395-405	400-405	443-449	415-422	418-425
MURPHY SAND													615-655	
SALTSBURG SANDSTONE									785-830	732-780		830-858	790-805	796-820
LITTLE DUNKARD SAND			740-778	774-800	820-840	632-662	774-800 GS 783-791				906-931	950-973	915-935	920-940
BIG DUNKARD SAND			897-942	894-1000	940-1030	805-850	925-975	712-785	1040-1070					
LOWER FREEPORT COAL				1020-1025		865-869	1009-1010							
FIRST GAS SAND						1030-1050								
FIRST SALT SAND	1210--		1236 -- GS 1247-56 45 MCF 1281-88 120 MCF 1288-93 270 MCF After 60 hrs 10 Bbls	1214-1328 GS 1314-15 2 MCF	1255-1379 Break 1318-1325 GS 1338-48, 1400 MCF	1117-1162 break 1142-43 GS 1147-48, 1131-38 2 MCF	1187-1305	1040- Hole full water	1335-1437 GS with water 1358 GS 1419	1285-1342 GS 1328	1316-1426 water at 1406	1350-1466	1300-1350	1312-1365
SECOND SALT SAND				1385-1388		1230-1245			1450-1490	1355-1398			1367-1405	1370-1430
MAXTON SAND														
BIG LIME				1470-1500	1520-1550	1278-1320	1437-1478		1530-1571 GS 1648	1497-1540	1516-1560	1560-1600	1503-1640	1525-1570
BIG INJUN SAND	1405	1360--		1500-1745	1550-1776 Break 1645-1658 GS 1634-46; 94 MCF	1320-1582 GS 1411-15 350 MCF 1428-38, 4 MCF	1478-1737 Break at 1715 GS 1530-66, 85 MCF	1335-1510	1571-1795 GS 1634 GS with Break 1640-1680	1540-1735	1560-1774 GS 1680	1600-1825	1540-1734	1570-1760
SQUAW SAND				1780-1925		1645-1655	1777-1802	1552-1584	1855-1865	1765-1785		1890-1903		
MURRYSVILLE SAND		1865--		2060-2095					2108-2140					
GANTZ SAND		2050--		2207-2247 GS 2213-28 35 MCF	2251-2285	2032-2107 GS 2064-65	2190-2265 GS 2235-2237 20 MCF	1968-2012 GS 1980	2252-2353 Break 2285-2297	2240-2285	2270-2298	2290-2320	2227-2252	2266-2295 GS 2277
FIFTY-FOOT SAND				2250-2305 GS 2268-82	2289-2348 Break 2316-31 GS 2330 2348, 496 MCF	2112-2147	2270-2320 break 2298-2305	2042-208	2353-2385	2296-2336 broken	2315-2368	2335-2360	2267-2315	2315-2340
UPPER NINEVEH SAND				2365-2380		2184-2196	2344-2368		2440-2465	2400-2426	2433-2446	2465-2475		
LOWER NINEVEH SAND										2435-2445			2417-2427	
GORDON STRAY SAND	2350--	2312---			2465-2473		2427-2440	2195-2235			2497-2515			
GORDON SAND	2385	2340--		2435-2500	2502-2546	2288-2328 break 2312-15	2447-2498	2241-2295 break 2253-27	2500-2597 GS, GS 2536 2530 Includes Gordon Stray	2502-2524	2518-2688 breaks 2537-2550 2596-2608 Oil 2534 & 2642	2525-2587 Oil break 2545 2565	2457-2523 breaks 2464-2481 2496-2508 Oil 2506	2490-2565 break 2550-2537 Oil 2545 & 2562
FOURTH SAND		2371---		2530-2550	2552-2589	2364-2380	2529-2558		2631-2653					
FIFTH SAND	2470 --- Gas	2425		2565-2605	2612-2643 G 2615-17; Tower 3622-31; 39 MCF	2401-2430 GS 2410-12			2672-2677				2590-2607 G.S. 2588 187 MCF	
TOTAL DEPTH			1260	2881	2645	2723	2825	2740	2757	2550	2616	2604	2612	2572
DEEPEST SAND DRILLED	Fifth	Fifth	First Salt	Elizabeth	Fifth	Elizabeth	Elizabeth	Elizabeth	Fifth	Gordon	Gordon	Gordon	Fifth	Gordon

TABLE OF SHEET 6

MAP NUMBER	2E-1	2E-3	2E-6	2E-8	2E-10	2F-1	2F-2	2F-3	2F-4	2F-5	2F-6	2F-12	2F-13	2G-1
NAME OF WELL	Buc-Lynn	Wilma Johnson	H. Hatfield	S. Linn	J.G Gushard	G. Boyle #3	J. Sankinc #2	J. Sankinc #1	J. Sankinc #3	W. Neill	J.L Kenamond	J.M. Pollock	S.Linn #3	Washerbaugh #2
OWNER	E. Beedle	J.H. Wilson	C.E. Young	Union Gas & Oil	Penn-Ohio Gas	E. Beedle	C.E Young	C.E. Young	C.E. Young	Peoples Nat. Gas	C.E Young	E.H. Teague	Union Gas & Oil	Jefferson Gas
DATE COMPLETED	1944	1945	1946		1925	1946	1946	1946		1945	1945	1929	1891	
ELEVATION	1078	1239	1343	1120	1121	1201	1189	1268	1225	1078+	1123	1024	1129	
PITTSBURGH COAL	287-292	440-446	574-575	398---	347-352	418-421	420-426	510-515	447-453	331-337	348-354 G.S.	275-280	400---	350---
MURPHY SAND	450-472	630-645					575-605	680-705	615-641	502-520				
SALTSBURG SANDSTONE	645-670	830-860	947-967		690-710	780-820		875-900	840-850	752-768				
LITTLE DUNKARD SAND	765-810	930-965	1067-1095		812-850							730-810		
BIG DUNKARD SAND							1022-1058	1100-1155		942-970	960-1020			
LOWER FREEPORT COAL			1246-1248							1028-1029				
FIRST GAS SAND	1080-1145 break 1105-1125	1225-1255 G.S.	1370-1395			1180-1220			1238-1296	1171-1191	1205-1215 G.S. 1210-1212	1045-1057		
FIRST SALT SAND	1193-1300 water at 1230	1345-1448	1475-1558 water		1228-1330	1400-1440	1333-1412	1418-1460 break 1434-1436	1368-1450 G.S. 1436-1438 water 1440-1446	1263-1324 water 1292 and 1318	1250-1270	1154-1274		
SECOND SALT SAND								1463-1530		1395-1420 G.S. 1401 with salt water	1353-1375			
MAXTON SAND	1355-1375					1500-1525				1430-1439				
BIG LIME		1545-1580	1658-1706		1425-1470	1525-1550		1617-1650	1540-1604	1449-1475	1435-1485	1392-1412		
BIG INJUN SAND	1420-1620	1580-1770 G.S. 1690	1706-1899 G.S. 1783 & 1815-1818		1470-1670 break 1545-1570	1550-1800 G.S. 1664-1670	1562-1795 break 1610-1616 water 1675	1650-1885	1624-1826	1475-1700	1496-1730	1412-1630		
SQUAW SAND										1759-1834		1695-1715		
MURRYSVILLE SAND			2246-2292					2225-2265		1996-2051		2004-2067		
GANTZ SAND	2125-2228 G.S. 2134, 2155 O.S. 2170-2173	2250-2359	2418-2455 O.S & G.S. 2446	2261---	2150-2190 G 2166-2165	2268-2321 G.S. 2307-2312	2267-2318	2395-2440	2297-2357 O.S feet - now brea	2170-2236 O.S & G.S. 2203, with 12 MCF 2201	2193-2250	2116-2140	2216-2292 Oil 2221 & 2270	
FIFTY-FOOT SAND	2230-2245	2365-2375	2463-2514	2270---	2198-2243	2330-2380 break 2352 2360	2328-2363	2450-2490	2366-2390	2262-2289	2260-2304	2150-2215 G.S.		
UPPER NINEVEH SAND		2425-2438	2578-2586			2418-2435	2420-2436	2540-2565		2343-2349	2350-2365	2242-2275		
LOWER NINEVEH SAND			2598-2606			2448-2455		2570-2580		2363-2373	2378-2400	2280-2310		
GORDON STRAY SAND	2365-2375				2378-2405		2490-2498		2529-2539		2430-2435			
GORDON SAND	2380-2425 O.S 2412-2415	2512-2555 G.S.	2668-2700		2450-2470 Oil 2467-2470	2522-2568 Oil 2536-2548 2556-2581	2510--2554 brown 2530-2536 Oil 2547 LP to Mkr	2637-2694 shell 2637-2643 Oil 2642-2647 LP to Mkr 2681-2694	2559-2592	2434-2467 O.S & G.S. 2443 38 MCF	2441-2487 Oil 2458-76 LP to Mkr 2474-80	2370-2465		
FOURTH SAND	2465-2478		2742-2748		2487-2525				2622-2639	2505-2515	2502-2540	2495-2510		
FIFTH SAND	2512-2525	2647-2660	2784-2808		2555-2570				2664-2696	2543-2569	2560-2593	2530-2544		2565--- Gas
TOTAL DEPTH	2728	3046	2817		3073	2570		2694	2806	2684	2610	2600	2299	2590
DEEPEST SAND DRILLED	Bayard Stray	Bayard Stray	Fifth	Fifty-foot	Bayard Stray	Gordon	Gordon	Gordon	Fifth	Bayard	Fifth	Fifth	Gantz	Fifth

TABLE 3. SHEET 6

MAP NUMBER	2G-2	2G-3	2G-7	2G-9	2G-10	2G-11	2G-12	2G-14	2H-2	2H-3	2H-4	2H-6	2H-7	2H-8
NAME OF WELL	Washerbaugh #3	T.B. Hixson Heirs	B. Levine	C. Sekuro	B. Levine	J.W. Neill #1	J.W. Neill #2	H.P. Mallenauer #1	J.M. Ballentine #1	J.C. Beabout #2	H. Davidson	J. Ballentine #2	F. Grego	E.M. Lorimer #1
OWNER	Jefferson Gas	Keystone Gas	Keystone Gas	Dunn & Moriarity	E.J. Dunn	Keystone Gas	Keystone Gas	Union Gas & Oil	Keystone Gas	Keystone Gas	Keystone Gas	Keystone Gas	Keystone Gas	Carnegie Nat. Gas
DATE COMPLETED		1946	1945	1946	1945	1939	1946			1938	1937	1943	1939	1943
ELEVATION		998	962	1038	974	1038	977	1070		1048	979	1128	1132	1113
PITTSBURGH COAL	440---	221-223	200-201	241-245	207-212	267-272	194-198	310---	309-315	252-258	203-209	349-355	352-359	337-343
MURPHY SAND														
SALTSBURG SANDSTONE				610-626										
LITTLE DUNKARD SAND			655-670			745-775	695-720 GS 703-706 slow cut		783-803	725-745	640-660	760-780	835-850	762-790
BIG DUNKARD SAND			790-838			852-900			875-941 GS 903	817-900	795-825	910-990	920-953	890-940
LOWER FREEPORT COAL			864-867 GS 26 MCF slow cut			941-944			963-968 Gas 963, 200 MCF	905-910	865-870		1018-1023	1007-1010
FIRST GAS SAND				1045-1055		1050-1075			1180-1242		1069---		1204-1219	1151-1195
FIRST SALT SAND		1133-1200 GS 1160, 20 MCF slow cut	1070-1167 GS 1134-37, 18 MCF slow cut water 1132 ft.	1160-1210	1125--- G 1137-42, 610 MCF HP 398 lbs in 6½ hrs	1146-1212	1015--- G 1133-37, 1475 MCF IRP 350 lbs.	1210---	1245-1267 Gas 1252-1264 300 MCF	1137-1212 Gas 1196-1205	GS 1128-29, 30 MCF GS 1139-40, 20 MCF G 1144-53, 450 MCF	1237-1332 break 1237-1312 G 1283-92, 150 MCF	1236-1312 break 1268-1270 GS 1306-08 water	1215-1300 Gas 1272-1276 180 MCF
SECOND SALT SAND														1332-1391
MAXTON SAND		1285-1308	1278-1284	1303-1340 GS 1321-1325 water 1334-1340		1318-1338								1395-1421
BIG LIME		1330-1380	1304-1330	1350-1391		1359-1378			1421-1457		1296-1354	1462-1505	1462-1486	1445-1494
BIG INJUN SAND		1380-1625 GS 1477, 12 MCF slow cut	1330-1580 GS 1423-25, 40 MCF 1440-44, 80 MCF	1391-1629		1378-1652 G 1497-1501, 150 MCF GS 1551-53		1447---	1457-1721		1354-1593	1505-1770	1492-1740 break 1634-1636	1494-1745 break 1645-1653
SQUAW SAND		1658-1677	1630-1665	1648-1705		1715-1742			1762-1820		1640-1678	1790-1851	1812-1828	1780-1817
MURRYSVILLE SAND									1910-2112					2041-2075
GANTZ SAND		2066-2120 break 2093-2100 GS 2112, 90 MCF slow cut	2048--- G 2048-52, 48 MCF 2080-90, 825 MCF	2089-2128		2114-2187 GS 2117-2121 12 MCF		2157---	2167-2202 Gas 2192, 2195 1½ MCF		2057-2121 Gas 2068-71, 800 MCF blowing down to 60 M	2210-2263 G 2256-2258 500 MCF	2216-2281 Gas 2218-2223 90 MCF	2199-2257 Gas 2218, 127 MCF
FIFTY-FOOT SAND		2125-2185		2134-2212 top 2 holes from 2182 ft. GS 2149-53, 68 MCF blew down to 18 MCF		2190-2208		2200	2206-2291 break 2268-2271		2127-2149 rest shale 2160-62	2265-2268	2288-2301 GS 2289-2291	2271-2320
UPPER NINEVEH SAND		2210-2230		2244-2254		2265-2275			2317-2332			2356-2404	2358-2375	2367-2383
LOWER NINEVEH SAND												2423-2433		2390-2417
GORDON STRAY SAND		2287-2304		2316-2322		2337-2344		2374---	2378-2391				2443-2452	2438-2458
GORDON SAND		2313-2357 GS 2330 18 MCF		2346-2391		2365-2413		2396---	2416-2457				2464-2504	2475-2515
FOURTH SAND		2389-2407		2403-2435		2445-2460		2448--	2465-2505		2382-2394		2540-2552	2550-2562
FIFTH SAND	2655 Gas	2426-2465 G.S.		2455-2489		2477-2510 G 2482-2485 150 MCF		2523--	2517-2554		2417-2445 Gas 2423, 2426 60 MCF		2570-2598	2577-2617 Gas 2593, 2595 and 2599
TOTAL DEPTH	2675	2751	2091	2783	1142	2759	1137		2915	1370	2707	2702	2902	2847
DEEPEST SAND DRILLED	Fifth	Elizabeth	Gantz	Bayard Stray	First Salt	Elizabeth	First Salt	Fifth	Elizabeth	First Salt	Elizabeth	Bayard	Elizabeth	Elizabeth

MAP NUMBER	2H-9	2H-10	2H-11	21-1	21-2	21-3	3D-1	3D-2	3D-6	3D-8	3D-9	3D-12	3D-13	3D-16
NAME OF WELL	W.A. Donaldson #1	E.M. Lorimer #2	W.A. Donaldson #2	J.C. Beabout #2	J. Stoltz 1	W. Hamilton #1	Lutton #4	Quail	Quail #2	Quail #2	Quail #1	Quail	Quail #1	Munce #18
OWNER	Carnegie Nat. Gas	Carnegie Nat. Gas	Carnegie Nat. Gas	Keystone Gas	Carnegie Nat. Gas	Peoples Gas	J. McCloy	West Farms Oil & Gas	Wm. Lindsey	McKeoun Oil	McKeoun Oil	McKeoun Oil	Wm. Lindsey	McKeoun Oil
DATE COMPLETED	1944	1944	1945	1943	1941	1941	1925	1925	1925				1925	
ELEVATION	1070	1066	1054	1159	1195	1172	1287	1238	1097	1322	1314	1120	1234	1112
PITTSBURGH COAL	307-313	289-295	298-306	372-378	412-418	396-404 Gas 400 mcf, 25 mcf water	460-467	434-441	292-297				410-414	320---
MURPHY SAND														
SALTSBURG SANDSTONE		630-668		785-805			846-880						810-840	
LITTLE DUNKARD SAND	738-798 GS 787		765-785		853-874		955-1000	925-945	777-805				900-943	
BIG DUNKARD SAND	865-952	860-829	881-920 water 881, GS 906 910, 25 mcf	940-1017	950-973	985-1029			925-945				1000-1005	
LOWER FREEPORT COAL		978-982				1067-1068								
FIRST GAS SAND	1112-1124 SO 1121 28, 36 MCF	1122-1143	1138-1141		1250-1275									
FIRST SALT SAND	1174-1232 Gas 1230 32, 65 MCF	1190-1251	1175-1268 water 1241-1244	1270-1367	1309-1370	1300-1383	1375-1504	1325-1520	1176-1312 little water				1295-1405	1190---
SECOND SALT SAND		1288-1386 break 1311-1327	1310-1380		1390-1465 break 1418-1446	1434-1462								
MAXTON SAND						1502-1536 Gas 42 MCF								
BIG LIME		1427-1452	1430-1448	1407(?)-1526	1529-1568		1592-1628	1540-1580	1414-1444				1554-1579	1420---
BIG INJUN SAND		1452-1722 Gas 1513-1561 38 MCF	1448-1780 break 1715-1718 GIS 1518 26, 260 MCF	1526-1747	1568--- Gas 1627-1633 1300 MCF	1550-1793	1628-1855	1580-1805	1449-1666				1579-1809	1470---
SQUAW SAND				1826-1887		1875-1905	1917-1946	1925-1940	1752-1770				1870-1910	
MURRYSVILLE SAND		2020-2055	2030-2048	2010-2145		2092-2134		2100-2158	1980-2050				2040-2220	1940---
GANTZ SAND		2161-2200 Gas 2165-2167 200 MCF	2165-2196	2234-2269 Gas 2239 2268 1/8 MCF		2254-2288	2318-2348	2250-2300	2145-2186 OS GIS 2148-2150	2355---	2360	2130	2273-2314 OS	2159---
FIFTY-FOOT SAND		2208-2290 break 2264 2278	2203-2278 break 2253-2272	2280-2333 break 2294-2306		2297-2347 Gas 2297 1/8 MCF	2365-2393	2315-2363	2200-2250	2409 Oil	2414 Oil 2414	2188 1/2-- Oil	2335-2371	2204--- Oil
UPPER NINEVEN SAND			2305-2318	2397-2418		2407-2430		2397-2428						
LOWER NINEVEH SAND			2332-2356	2425-2435		2435-2450								
GORDON STRAY SAND		2398-2416	2396-2407					2477-2490	2340-2360					
GORDON SAND		2422-2480 break 2460-2466	2413-2456	2492-2528		2522-2562	2550-2606 break 2578-2585	2493-2567 break 2545 2548 GIS 2549 (2543-67)	2385-2448 break 2387-2402				2519-2580 break 2527-2532	
FOURTH SAND		2600-2512 GS 2508	2498-2507	2535-2576		2580-2586	2638-2658		2467 2499 Gas 2482				2595-2635 break 2610-2620	
FIFTH SAND		2526-2562	2514-2552 G 2528, 2532 50 MCF			2609-2645 Gas 2629 50 MCF			2524 2560					
TOTAL DEPTH	1232	2800	2591	2752	1635	2951	2662	2578	2560	2454	2466		2700	
DEEPEST SAND DRILLED	First Salt	Elizabeth	Fifth	Beyard Stray	Big Injun	Elizabeth	Fourth	Gordon	Fifth	Fifty-foot	Fifty-foot	Fifty-foot	Fourth	Fifty-foot

TABLE 3, SHEET 8

MAP NUMBER	3E-14	3E-18	3E-20	3E-23	3E-24	3E-25	3F-1	3F-2	3F-4	3F-8	3F-9	3F-10	3F-11	3F-12
NAME OF WELL	J Wright #1	Thome #1	J Wright #4	Thome #3	Thome #4	R Christopher	S Linn #4	J W Pollock #1	J W Pollock #6	J W Pollock #2	S Linn #6	J W Pollock #2	Rooney #5	R Herron Heirs
OWNER	Charliers Oil		Charliers Oil			C H Young	Union Gas & Oil	Union Gas & Oil	Union Gas & Oil	Union Gas & Oil	Union Gas & Oil	Union Gas & Oil	M'g Light & Heat	Union Gas & Oil
DATE COMPLETED	1886		1887			1945				1895	1892			1893
ELEVATION	1147		1246			1313	1080	993	1050+	1075	1230	1205	1300	1255
PITTSBURGH COAL				480--	590-	588-594	350---	280---	324---	359---	515---	490--	599---	550--
MURPHY SAND														
SALTSBURG SANDSTONE						940-975								
LITTLE DUNKARD SAND						1045-1080								
BIG DUNKARD SAND						1139-1240								
LOWER FREEPORT COAL														
FIRST GAS SAND														
FIRST SALT SAND						1455-1570 Water 1368								
SECOND SALT SAND														
MAXTON SAND														
BIG LIME						1675-1720							1706	
BIG INJUN SAND						1720-1955							1745	
SQUAW SAND														
MURRYSVILLE SAND														
GANTZ SAND	2211½-2248 Gas near bottom	--2340	2329 Gas 2319 Oil 2330			2415--	2197--	2100	2165	2192--- Oil 2190 2210 2267 2287 mi-al	2348 Oil 2357	2343-- Oil	2432--	2375-2434 Oil 2385 & 2395
FIFTY-FOOT SAND	2255--		2348			--2535		2162	2211½			2376	2489--	
UPPER NINEVEH SAND						2570-2587								
LOWER NINEVEH SAND														
GORDON STRAY SAND														
GORDON SAND						2660-2702								
FOURTH SAND						2733-2763								
FIFTH SAND		2630-- Gas 2636		2700--	2795 Gas 2800	2785-2816 Gas 2790 2793 131 mcf	2558---	2490			2726 Gas			
TOTAL DEPTH	2281½	2660	2385	2750	2830	2928				2257	2747			
DEEPEST SAND DRILLED	Fifty-foot	Fifth	Fifty-foot	Fifth	Fifth	Fifth	Fifth	Fifth	Fifty-foot	Gantz	Fifth	Fifty-foot	Fifty-foot	Gantz

MAP NUMBER	3F-13	3F-14	3G-1	3G-3	3G-4	3G-5	3G-6	3G-7	3G-9	3G-12	3H-1	3H-2		
NAME OF WELL	R Herron Heirs #2	Rooney well #2	H P Mallenauer #4	J W Pollock #1	H P Mallenauer #2	H P Mallenauer #1	J W Pollock #3	H P Mallenauer #3	R Herron Heirs	C M Reed	J R Gamble #1	B R Rush #1		
OWNER	Union Gas & Oil	Chartiers Oil	Union Gas & Oil	Union Gas & Oil	Union Gas & Oil	Union Gas & Oil	Union Gas & Oil	Union Gas & Oil	Union Gas & Oil	Assoc. Producers	Carnegie Nat Gas	Foley & Williams		
DATE COMPLETED						1896	1901			1886	1933	1946		
ELEVATION	1115	1325	983 +	1050 L	1140	1205	1154	1155	1100	960	1046	1108		
PITTSBURGH COAL	415 --		240	324 --	455 --	464 --	436 ---	435 ---	385 ---	260 ---	288-300	374-382		
MURPHY SAND														
SALTSBURG SANDSTONE												755-770		
LITTLE DUNKARD SAND														
BIG DUNKARD SAND												1016-1025		
LOWER FREEPORT COAL												1066-1072		
FIRST GAS SAND														
FIRST SALT SAND											1179-1266 water 1250	1266-1350		
SECOND SALT SAND												1434-1481		
MAXTON SAND											1385-1410 GS 1396			
BIG LIME											1430-1465	1504-1537		
BIG INJUN SAND			1390 ---								1465-1685	1537-1786		
SQUAW SAND														
MURRYSVILLE SAND												2102-2134		
GANTZ SAND	2253 -- Oil	2367-2399	2084	2165	2291	2308½-2351 Oil, has pay from 2331 to 2351 and gas 2308 to 2324	2271-2318 Oil, has pay between 2271 & 2284 & 2294 & 2318	2283 ---	2228 ---		2170-2195	2244-2287 Gas 2249, 2251 & 2281		
FIFTY-FOOT SAND		2414-2432 GS & GS	2124	2211½	2358	2363-2392 black & shelly	2322-2362	2333	2278 ---	2147 --	2208-2285 break 2260-2270 G 2268, & break 2280-2285 GS &	2294-2346 Gas 2298, 2304 & 2310		
UPPER NINEVEH SAND											2315-2335			
LOWER NINEVEH SAND											2340-2365			
GORDON STRAY SAND			2307								2385-2411			
GORDON SAND			2337											
FOURTH SAND			2378								2469-2505			
FIFTH SAND		2740 -- Gas strong	2450							2490 ---	2530-2559 Gas 2543			
TOTAL DEPTH		2760									2858	2358		
DEEPEST SAND DRILLED	Gantz	Fifth	Fifth	Fifty-foot	Fifty-foot	Fifty-foot	Fifty-foot	Fifty-foot	Fifty-foot	Fifth	Elizabeth	Fifty-foot		

Joseph Senkinc #2 ... Am 2F2*
Joseph Senkinc #3 ... Am 2F4*
Speir Heirs ..... Car 15I1*
John Stoltz ..... Am 2I2*

T

Templeton Heirs ..... Am 2F7
Templeton Heirs ..... Am 2F8
Templeton Heirs ..... Am 2F9
Templeton Heirs ..... Am 1G16
Templeton Heirs ..... Am 1G17
Sam Thome #1 ..... Am 3E18*
Sam Thome #3 ..... Am 3E23*
Sam Thome #4 ..... Am 3E24*
Sam Thome ..... Am 3E16
Sam Thome ..... Am 3E17
Wm. Thome ..... Am 3D10
Wm. Thome ..... Am 3D11
Thompson ..... Am 2D4

W

E. G. Walker #1 ..... Am 1F7*
E. G. Walker #2 ..... Am 1G7*
W. B. Washerbaugh #1 Am 1G15*
W. B. Washerbaugh #2 Am 2G1*
W. B. Washerbaugh #3 Am 2G2*
George Weaver ..... Car 15E1
H. H. White ..... Car 15E3
Harry H. White ..... Am 1F1*
Samuel White (old well) ..... Am 1E3
Samuel White (Young) Am 1F3*
Mary W. Wilson ..... Am 2G15
Thomas Wilson ..... Car 15E2
Clifford Winnette ..... Am 1E1*
Dorsey Woodruff ..... Am 2D2*
Joshua Wright #1 .... Am 3E14*
Joshua Wright #4 .... Am 3E20*
Joshua Wright ..... Am 3E13
Joshua Wright ..... Am 3E15
Joshua Wright ..... Am 3E21
R. D. Wylie ..... Am 3C8

Y

George Yatsko #1 .... Car 15H5*
George Yatsko #2 .... Am 1H2*
J. T. Yoney #1 ..... Am 1E4*

Z

Wm. Zediker ..... Am 3H3